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TWO PARASITIC MUSHROOMS

EDWARD T. HARPER

(WITH PLATES 177–179, CONTAINING 14 FIGURES)

VOLVARIA LOWEIANA (Berk.) Pat.

Specimens of this parasite on *Clitocybe nebularis* were found by a member of the Minnesota Mycological Society in the autumn of 1915 and sent to me by the president of the Society, Dr. Mary S. Whetstone. Several collections both of the parasite and the uninfected host plant were received, from which the accompanying photographs were made. The plants grew in an area about ten feet square on the ground among leaves about a cluster of waxberry bushes. The host mushrooms had been collected from this locality and eaten for four years, but the parasite did not appear until the present season.

The host plants are deformed by the parasite and become irregular masses, like the so-called abortive forms of *Clitopilus abortivus* and *Armillaria mellea*. Whether their structure is similar to that of the host of *Pilosace algeriensis* described below could not be determined from my specimens. The illustrations of the European plants show less malformation of the host. The *Volvaria* appears as small, white, spherical bodies on the pileus of the host and has a normal development like that of *Volvaria bombycina*.

The specimens agree in all essential characters with Maire's description in the Bull. Soc. Myc. de France, Tome XXVII, fasc. 4, and I can add little from my material. The spore measure-

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ments agree with those given by Maire, 4–5 × 6–7 μ, much larger than those reported in the Sylloge, by Stevenson, etc.

Pileus 1–2 inches broad, ovoid or globose, becoming campanulate and expanded, obtuse, broadly umbonate, villous-silky, dry, not striate, fimbriate on the involute margin, white; flesh solid, white or with a tinge of pink; lamellae slightly ventricose, attenuated in each direction but somewhat broader in front, free, white-floccose on the edges, becoming pink and finally reddish with spores; stem about 2 inches long, 2–3 lines thick, slightly bulbous at the base, equal or somewhat attenuated upward, solid, white, fibrillose; volva white, covering the bulbous base of the stem, free margin short, lobed; spores pink to reddish in mass, ovoid or ellipsoid, 4–5 × 6–7 μ, membrane thick, vacuoles one or two; basidia club-shaped, enlarged below the apex, 7 × 30 μ, contents granular; cystidia numerous especially on the edges of the lamellae, ventricose, accuminate above with a cylindrical obtuse apex, 8–15 × 45–70 μ.

Parasitic on *Clitocybe nebularis*.

Quélet considered *Volvaria Loweiana* as a luxuriant parasitic form of *Volvaria plumulosa* Lasch. The latter grows on the ground among humus in fir woods. Maire, who has studied both forms, agrees as to the identity of the two species, though he finds some minor differences between them. The most important difference is that the spores of *Volvaria plumulosa* are a little broader and shorter than those of *Volvaria Loweiana* but, as both Patouillard and Britzelmayr give the spore measurements of *Volvaria plumulosa* fully as long as those of *Volvaria Loweiana*, he concludes that the size of the spores may be variable. Maire gives photographs of both the parasitic and terrestrial form. The group includes *Volvaria Loweiana* (Berk.), *Volvaria plumulosa* (Lasch), *Volvaria parvula* var. *major* Wein., and *Volvaria hypopitys* Fries.

I collected plants of this group on the ground under coniferous trees at Frankfort, Mich., in August, 1911, but did not secure a photograph of the fresh plants. The dried specimens are shown in *pl. 177, f. C*. They agree with *Volvaria plumulosa* as described and illustrated by Maire. The plants were white with a villous, silky pileus, even, not striate on the margin. The stem was silky-fibrillose, solid, slightly bulbous at the base, where it was covered

by the white volva. The plants were less robust and a little smaller than *Volvaria Loweiana*. Most of the spores were 4–5 × 5–6 μ agreeing with Maire's observation though many spores 7 μ in length were to be found. The basidia and cystidia in the two plants agreed exactly, which is especially significant in the case of the cystidia which have a peculiar shape. The plants are certainly closely related, though cultures would be necessary to prove their identity. This would be difficult to accomplish with such rare plants. Worthington Smith succeeded in growing *Volvaria Loweiana* on *Clitocybe nebularis*.

The limits of the group in this country are not well fixed. Several forms should be kept in mind by collectors.

1. *Volvaria villosa-volva* Lloyd, Myc. Notes **4**: 31 and photograph No. 81. The plants were found among dead leaves of deciduous trees and had the volva overgrown with white, mycelioid hairs. Otherwise they agreed with *Volvaria plumulosa*, as they had an even pileus and solid stem. The spores are said to be globose, 5 μ in diameter. The white, myceloid base of the stem is not remarkable in plants growing among dead leaves.

2. *Volvaria umbonata* Pk. Bull. Torrey Club **26**: 64–65. 1899. The species was based on plants found in Ohio by Lloyd, which grew in lawns and grassy places. It is illustrated by Hard, *Fig. 194*, who found it not uncommon at Chillicothe, Ohio. The species is distinguished from *Volvaria plumulosa* by its striate and slightly viscid pileus. In these respects, it agrees with *Volvaria parvula* Wein., from which it differs in the solid stem. The spores are 4–5 × 5–7 μ exactly like those of *Volvaria Loweiana* and the other members of the group. Peck considers *Volvaria umbonata* as akin to *Volvaria media* but distinguished by the larger spores. The reports of the spores of *Volvaria media* may, however, be incorrect.

3. *Volvaria pusilla* Pers. It has often been reported from this country and is considered the same as *Volvaria parvula* Wein. The pileus is striate and viscid and the stem hollow, so that it represents the opposite extreme of the group from *Volvaria Loweiana*. It is also the smallest member of the group. The spores and basidia are characteristic of the group, as are in all

probability the cystidia also, the measurements of which are given in the Sylloge as 6–7 × 50–55 μ.

All the members of the group agree in their fruiting bodies and in general appearance and color. They differ in various combinations of the characters, solid or hollow stem, even or striate pileus, and dry or viscid surface. *Volvaria Loweiana* is a case where parasitism has resulted in robust and luxuriant growth.

Volvaria Loweiana was collected by Prof. John Dearness at London, Ontario, Canada, in October, 1896, and distributed in North Amer. Fungi, No. 3509. In my specimen, the spores of the parasite are 4–5 × 6–8 μ. No part of the host is present, but it is said to grow parasitic on *Clitocybe*. Prof. Dearness informs me that the host is *Clitocybe nebularis* and that the spores of the host measure about 2.75 × 5 μ. He never found it on any other species. Lloyd's note in *Volvae* that *Volvaria Loweiana* was found on *Clitocybe monodelpha* is an error.

The host plant, *Clitocybe nebularis,* is very widely reported from both Europe and America, but the limits of its group are not well understood. Peck confines the species to plants with small spores, 2–3 × 4–5 μ, and reports it as rare in New York State, having been found in only two or three localities. He illustrated it in Ann. Rep. N. Y. State Mus. **48**: *pl. 23, f. 8–13.* Murrill in Mycologia, Sept. 1915, p. 268, says the spores of the European plant are 5–7 × 8–10 μ and that Peck's illustrations are not suggestive of the European form.

There were two forms of the host of *Volvaria Loweiana,* both growing in the small area where the parasite was found. One is shown in *pl. 178, f. A, B.* The pileus was convex, whitish or with a slight tint of yellow, covered with a slight pruinosity, and often disfigured by dirt and humus. The lamellae were decurrent, adnate or even sinuate when young, becoming long-decurrent when mature. The stem was short, much thickened and often curved at the base. The spores were small, 3–4 × 5–6 μ. The plants agree with the figures of Gillet and Britzelmayr except that the stems are shorter. Britzelmayr gives the spore measurements as 4 × 6–8 μ. The second form is shown in *pl. 177, f. D.* It had a more equal stem gradually tapering upward, and the pileus was dark-smoky-gray. The spores were slightly smaller than in the

first form, 2–3 × 4–5 μ. They agree with Peck's measurements, and also with those given in the Sylloge, 2.5–3 × 4–5 μ, and by Stevenson, 3 × 4 or 3 × 3–5 μ. The plants also agree with Peck's illustration and in general with that of Massee in British Fungi and Lichens.

A very closely related group is that which contains *Clitocybe robusta* and *Clitocybe nobilis* of Peck, *Clitocybe candida* of Bresadola, and, in Quélet's opinion, also *Paxillus Lepista*. These plants, as I have seen them growing among leaves in open woods in Wisconsin, can scarcely be distinguished from the form of *Clitocybe nebularis* shown in *pl. 178, f. A, B*. They have a thick, white, convex to depressed pileus. The lamellae are adnate or sinuate to long-decurrent. The stems are usually short with much enlarged, often curved bases. The spores are, however, larger, 4–5 × 7–9 μ in my specimens, 4–5 × 6–8 μ and often slightly ochraceous in *Clitocybe robusta*, 4–5 × 7–8 μ in *Clitocybe nobilis*, and 3 × 7 μ in *Clitocybe candida*.

PILOSACE ALGERIENSIS (Fries) Quél.

In *Mycologia*, May, 1913, pp. 167–169, I gave reasons to show that the mushroom parasitic on species of *Coprinus* and described in this country as *Panaeolus epimyces* Peck and *Stropharia coprinophila* Atk. was the same as that illustrated by Lanzi, Fung. Mang, *pl. 67*, and identified as *Pilosace algeriensis*. During the past season, Dr. Mary S. Whetstone sent me several specimens of the plant found near Minneapolis, Minn., and from them I secured the photographs in *pl. 178, f. C, D and pl. 179, f. A*. A comparison with Lanzi's *pl. 67, f. b, c, d*, leaves no doubt that his specimens were parasites and the description proves their identity with the species before us. The lamellae of the parasite become wholly free from the stem as the pileus expands. The substance of the stem is not continuous with that of the pileus as can be seen in *pl. 179, f. A*, and the pileus easily separates from the stem. The plant has a universal veil which leaves the pileus and the base of the stem scaly, but there is no evident volva or annulus. The spores have a purple or brownish tinge rather than clear black. Hence the species is more naturally placed in *Pilosace* than in *Panaeolus* or *Stropharia* as was recognized by Fries, Quélet, and

Lanzi. *Pilosace algeriensis* appears to be very rare in Europe. Prof. Maire informs me he has never seen the species.

In addition to what has been said about the species by Peck, Atkinson, McKenna, Miss Sherman, and in my former article, some points regarding the effect of the parasite on the host plant are shown in these illustrations.

The carpophores of the parasite grow from the center of the pileus of the host either singly or in clusters. A comparison with the normal forms of the host, *pl. 179, f. C, D,* shows that the parasite has prevented the natural elongation of the stem. In very young carpophores of *Coprinus,* before the stem has begun to elongate, the gill chambers open outward and more or less downward with their bases and outer ends in the substance of the pileus, and their inner ends in that of the stem, although the exact point where the stem ends and the pileus begins, is somewhat arbitrary at this early stage of development. The mouths of the chambers are closed by the tissue of the veil, which is continuous with the trama of the gills. This is seen in Levine's figures of the young stages of *Coprinus micaceus,* Amer. Jour. Bot. **1**: *pl. 39, f. 13–14* and *pl. 40, f. 9.* I have no photographs of the young stages of *Coprinus,* but the sections of *Agaricus arvensis, pl. 179, f. E, F,* are similar in the position of the young gill chambers. In *f. E,* the chambers point diagonally upward. Compare Atkinson's illustrations in the Amer. Jour. Bot. **1**: *pl. 1.*

In normal non-parasitized plants of *Coprinus atramentarius,* the elongation of the stem and the simultaneous epinastic growth in the pileus results in a reversed position of the gill chambers so that when the pileus is formed and ready to expand the chambers lie in a vertical position with their bases outward and their edges towards the stem as in *f. D.* In plants which are parasitized, the elongation of the stem is inhibited and the enlarged gill chambers still lie obliquely upward with their mouths outward in the position which they have in the fully expanded carpophore of a mushroom of which the pileus becomes obconic or infundibuliform. Thus is formed the top-shaped mass of the host plant shown in the illustrations.

The substance of the veil which is left near the base of the stem in normal plants, *pl. 179, f. C,* becomes greatly thickened and

enlarged and covers the mouths of the gill chambers up to the margin of the pileus with a thick coat, *pl. 179, f. B*, and *pl. 178, f. C*. The base of the stem is also much thickened and does not become hollow. In many cases, there is a solid mass of parasitized stem, veil, and gill tissue and no annular gill cavity is formed, but often a more or less evident slit appears between the gills and veil as in *pl. 179, f. A*. This is the cleft observed by Lanzi and interpreted by him as connected with the formation of a ring.

The gills of the host plants attain nearly normal size and sometimes produce spores but are more or less parasitized. The substance of the pileus appears to be least affected and is not greatly thickened in the plants observed. The mycelium of the parasite causes the greatest deformation in the stem and the fruiting bodies are produced from the apex of the stem. This would suggest that the mycelium enters the host from beneath, but the method by which the *Coprinus* becomes infected is unknown.

I can offer no suggestion as to the group to which *Pilosace algeriensis* belongs nor to what non-parasitic mushroom it is nearest akin.

GENESEO, ILLINOIS.

EXPLANATION OF PLATES CLXXVII–CLXXIX

PLATE CLXXVII

Fig. A. Two mature plants of *Volvaria Loweiana* growing from the deformed pileus of *Clitocybe nebularis*.

Fig. B. A single carpophore of the parasite showing the volva.

Fig. C. Two plants of *Volvaria plumulosa* taken from dried specimens.

Fig. D. Form of *Clitocybe nebularis* with nearly equal stem and dark-fuscous pileus.

PLATE CLXXVIII

Fig. A. Large plant of the form of *Clitocybe nebularis* with thick bulbous stem, white pileus, and decurrent gills.

Fig. B. Small plant with adnate or sinuate gills.

Fig. C. Deformed *Coprinus* with a single carpophore of *Pilosace algeriensis* growing from the center of the pileus.

Fig. D. Section of the host showing the depressed pileus with the parasite in the center, the enlarged base of the stem, and the thickened veil covering the edges of the gills.

PLATE CLXXIX

Fig. A. Vertical section of both the host and the parasite. The gill slit has been pulled open slightly. Compare with *Pl. 178, f. D*.

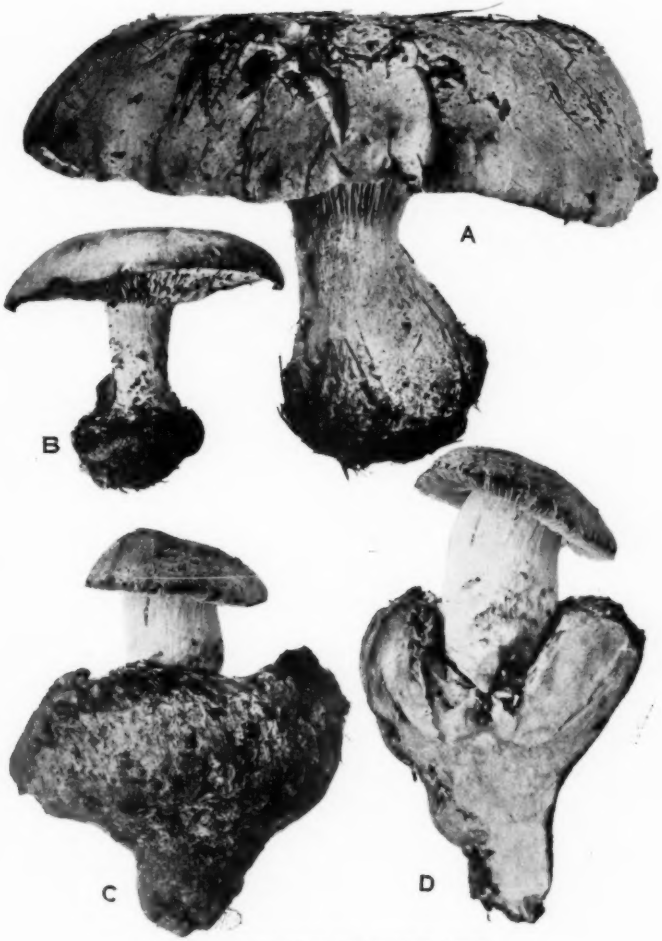
Fig. B. Outer surface of an infected host showing the junction of the pileus and the thickened veil.

Fig. C. Young carpophore of *Coprinus atramentarius* unaffected by the parasite.

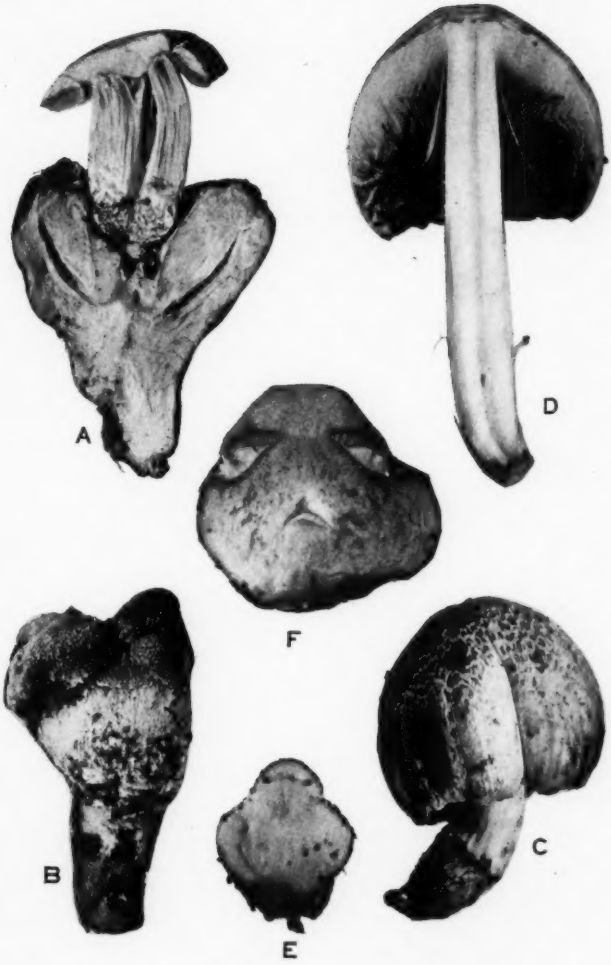
Fig. D. Vertical section showing the position of the gills when the pileus begins to expand.

Fig. E. Section of a young carpophore of *Agaricus arvensis* showing the position of the gill chambers.

Fig. F. Section of a somewhat older carpophore in the growing state, showing the lines of growth, position of the gills and the partial veil when the stem begins to elongate.



A, B. CLITOCYBE NEBULARIS
C, D. PILOSACE ALGERIENSIS



A, B. PILOSACE ALGERIENSIS
C, D. COPRINUS ATRAMENTARIUS
E, F. AGARICUS ARVENSIS

REMARKABLE FOSSIL FUNGI

EDWARD W. BERRY

(WITH PLATES 180–182, CONTAINING 16 FIGURES)

Among the relics of former vegetation that carry the record back many millions of years the remains of fungi are so rarely found that their presence is always exceptional, although it is obvious that many times during the long history of the earth the environment has offered optimum conditions for their abundant development. To mention but one such occasion, that of the formation of the coal measures must have witnessed an exceedingly abundant mycological flora. That these plants were present thus early is indicated by the abundance of hyphae, and other traces of fungal activity such as butyric fermentation, in the tissues of Carboniferous vascular plants, and the scarcity of described forms must be attributed to the perishable nature of most fungal tissues and to the lack of systematic work by experienced mycologists on the more or less obscure material available. To be sure, quite a considerable number of fossil forms referred to Fungi have been recorded from various geologic horizons but the vast majority of these are leaf-spot types based upon real or fancied resemblances, and found on impressions of foliage and without definite botanical characters. Some undoubtedly represent fungal ravages, others are due to insects, some are glandular, and others are purely imaginary.[1]

Sometimes the traces of fungi preserved in petrified plant tissues are fortunately disclosed in sections and a number of well authenticated forms are known, principally from the Carboniferous, their discovery being due almost entirely to the relatively large amount of histological work that has been expended on the Carboniferous flora. Some of the more important of these will be mentioned in the following pages. The exceptional conditions of

[1] For a rather complete illustrated list of all of these forms down to the year 1900 the student is referred to Meschinelli, A., Fungorum Fossilium omnum Iconographia, 1902, 144 pp., 31 pls.

preservation afforded by the accumulations of amber at a time long subsequent to the Carboniferous have given us a glimpse of some few fungal types of the older Tertiary.

In the examination of a large series of petrified woods (the majority of which are of Tertiary age) for the United States Geological Survey, I have frequently noted the ravages of parasitic fungi as well as branching mycelia of both septate and non-septate hyphae. Most of these are too indefinite for incorporation in the record, but it may be safely concluded that fungi were obviously as abundant then as now, and among the remains discovered several are so exceptionally well preserved that their description becomes important to both the botanist and geologist.

The first of these may be called **Peronosporoides palmi** sp. nov., not so much because I am certain that it is related to the modern genus *Peronospora*, but because it resembles various living species in that genus and I believe is clearly referable to the Peronosporaceæ. It may be described as far as the nature of the material permits as follows:

Mycelium intercellular, freely branching, with fused cross branches. Hyphae thin, .0025 mm. to .00375 mm. in diameter, profusely septate, the lengths of the cells variable, no clamp connections observed. Oögonia intercellular, numerous, relatively large, spherical, terminal, about .0357 mm. in diameter. Antheridia somewhat smaller, about .0238 mm. in diameter, subspherical. Objects having all the appearance of oöspores or zoöspores are distinctly visible in some of the oöginia. *Pl. 180, f. 2*, shows two partially collapsed antheridia in conjugation with oögonia and the oögonia which are interpreted as containing oöspores are found in those oögonia as in *Pl. 180, f. 3*, where the antheridium is completely collapsed and only a trace of it is left or where it has entirely disappeared.

This form is exceedingly abundant and beautifully silicified in a small stem (about 7 cm. in diameter) of *Palmoxylon cellulosum* Knowlton from the lower Oligocene of Mississippi. Oögonia and antheridia are plentiful both in the broken down fibro-vascular bundles and in the intercellular spaces of the parenchymatous ground mass of the stem. Several of the oögonia show what are clearly to be interpreted as spores and after making a careful survey of the literature I feel justified in asserting that this is the

best preserved fungus thus far discovered. It is true that this Oligocene species is very similar to the type figures of *Peronosporites antiquaria* Worthington Smith[2] but his figures are evidently idealized from his knowledge of recent fungi, if reliance can be placed on Seward's statement[3] that "Prof. Williamson and others have carefully examined the specimens, but they have failed to detect any trace of reproductive cells enclosed in the spherical sacs." Whether this does or does not do an injustice to the original describer of *Peronosporites antiquarius* I am unable to state, but feel disposed to give full weight to Seward's statement since this form has been found to be quite abundant in the scalariform tissues of *Lepidodendron* and both Cash and Hick[4] and Williamson[5] have described similar material. The latter author states that an examination of Smith's type as well as additional slides failed to show any oöspores or any septation of the hyphae and he states that its botanical relations are with the Saprolegnieae and not with the Peronosporaceae.

A form very similar to the English species has been described from the French coal measures as *Palaeomyces* by Renault,[6] and Coulter and Land[7] have recently figured what appear to be antheridia and oögonia which they found in rootlets that had penetrated a *Lepidostrobus* cone from the Carboniferous of Warren County, Iowa. Jeffrey[8] has described and figured a fungus found in the Tertiary lignites of Brandon, Vermont, which he calls *Sclerotites brandonianus* and which while he interprets it as a sclerotium stage, is not unlike *Peronosporoides palmi*, although it occurs in dicotyledonous instead of monocotyledonous wood and is not nearly as well preserved as the latter species.

To avoid any possible errors of representation, I have therefore

[2] Gardeners Chronicle, vol. 8, 1877, p. 499.

[3] Fossil Plants, 1898, p. 218.

[4] Cash and Hick, On fossil fungi from the Lower Coal-Measures of Halifax. Proc. Yorkshire Geol. Polyt. Soc., vol. 7, 1878, p. 115.

[5] Williamson, W. C. Philos. Trans. Roy. Soc., vol. 172, 1881, p. 300, pl. 48, figs. 36–38; pl. 54, figs. 28–33.

[6] Bassin houiller et permien d'Autun et d'Epinac, Fasc. IV, 2e partie, 1896, pp. 439, 441, figs. 88, 89, 90.

[7] Coulter and Land, Bot. Gaz. vol. 51, 1911, p. 452, figs. 21–23.

[8] Jeffrey, E. C., Geol. Surv. Vermont, Rept. from 1905–1906, p. 200.

illustrated this species photographically, although drawings would bring out the details to better advantage. I have submitted specimens to the mycologists of the Bureau of Plant Industry and wish to record my indebtedness to Mrs. Flora W. Patterson, the Mycologist in Charge of the Pathological Collections, for information and suggestions. She has confirmed the presence of oöspores in some of the oögonia and was disposed to consider the form identical with *Peronosporites antiquarius*. In review of the statements of Murray (in the Academy, Nov. 17, 1877), and of Williamson and Seward mentioned above, it is obvious that we are dealing with a distinct form. Due weight must also be given to the enormous time interval between the Carboniferous and Oligocene, as well as the geographic interval between Yorkshire and Mississippi. Moreover the oögonia of the American species are more than twice the size of the supposed oögonia of *Peronosporites antiquarius*.

Regarding the botanical position of the present form it is clearly a Phycomycete and belongs to the group Oömycetes. In the latter group I cannot find any family of existing forms to which it can be referred other than the Peronosporaceae. It is, of course, necessary to consider whether the existing families extend back in time some million of years, and on this point I am inclined to think the endoparasitic forms have varied but little since they assumed their present mode of life in their substantially unchanged environment. The Peronosporaceae are commonly thought of as exclusively endoparasitic in leaves and as exserting their spore-producing apparatus into the air through stomata or dissolved cuticles, thus producing the familiar downy mildews. A number of forms have, however, been observed in which the older mycelial branches in rotting tissues swell up and form antheridia and oögonia within these tissues and it is a reasonable assumption that Peronospora-like extinct genera, which perhaps if they could be studied with the facility of existing forms would be referred to extinct families, have existed in past time. I have therefore proposed the generic term *Peronosporoides* for forms like the present which resemble the modern Peronosporaceae and are undoubtedly filiated types.

[9] Felix, J. Zeitz. deutsch. geol. Gesell., 1894, p. 276, pl. 19, fig. 1.

The second form appears to be referable to the genus *Cladosporites* proposed by Felix[9] in 1894 for an Eocene form from Perekeschkul, Austria. It may be called **Cladosporites oligocaenicum** sp. nov. in allusion to its occurrence in wood of lower Oligocene age. It is found in the same rotten stem of *Palmoxylon cellulosum* Knowlton as *Peronosporoides palmi.* It shows a much-branched intra-cellular mycelium with united side branches and made up of fine, much-septate hyphae .0028 mm. in diameter. These hyphae proliferate freely within the cells of the parenchyma and occasionally are observed to send off haustoria to the walls. They frequently show terminal conidia which are in linear pairs, triplets or quadruplets, being generally in pairs or triplets. The conidia are sub-spherical in form and range in diameter from .0035 mm. to .0054 mm. For example, in *Pl. 181, f. 4,* the proximal segment is .00357 mm. × .004 mm.; the middle segment is .0045 mm. × .0054 mm.; and the distal segment is .0036 mm. × .004 mm. Associated with these well marked conidia and borne on hyphae of similar size are the objects shown on *Plate 181, fig. 2, 5, and 8,* which it would seem can best be interpreted as zygosporangia. They are without preserved contents and are not certainly identified with *Cladosporites oligocaenicum. Cladosporites* was named by Felix from its resemblance to the members of the existing genus *Cladosporium* Link, but since the habit of forming chains of conidia is a widespread one in the Fungi and the fossil forms are all endoparasites in the vascular axis of trees, the present species being an intra-cellular parasite, I am not prepared to say that they should be referred to the Didymosporae of the Hyphomycetes (Lindau) or just what their nearest existing relatives should be considered to be. An additional species of *Cladosporites* was recently described by Whitford[10] from the Pliocene Snake Creek beds of Nebraska.

The third new species to which I wish to call attention may be named **Cladosporites fasciculatus** sp. nov. It is found in exceeding abundance in silicified specimens of lauraceous wood from the middle Eocene (Yegua formation of the Claiborne group) of

[10] Whitford, A. C., University Studies, Univ. of Nebraska, vol. 14, 1914, 3 pp., 2 pls.

Texas and is entirely unlike any previously recorded fossil forms. I do not know its botanical affinity and rather than multiply generic terms of unknown botanical value I have preferred to refer this and the preceding species to Felix's genus *Cladosporites*, being influenced in the case of the present species by its resemblance to the existing *Cladosporium herbarum* (Pers.) Link. It may be incompletely described as follows: Mycelium intra-cellular, in the vessels of the secondary wood, attached to the vessel walls by haustoria, and forming small fasciculate apparently unbranched tufts projecting freely in the vessel cavity. The hyphae are thin and the majority are somewhat tapering distad although in some cases they taper proximad. Septa were not observed. In only one case was a distal branch observed (*Pl. 182, f. 1.*) Although there are some hundreds of tufts of this fungus in the slides examined, only two of these show conidia (*Pl. 182, f. 2*). The latter are terminal, fusiform in outline and somewhat variable in length. They appear to be simple and I am unable to assert positively that they are cut off from the hyphae by septa although I imagined that I saw such septation. The hyphae average about .0013 mm. in diameter and the conidia range from .002 mm. × .004 mm. to .002 mm. × .012 mm. in diameter.

Associated with this species are rambling mycelial hyphae which clamber over the vessel walls. These bear numerous antheridia and oögonia or sclerotia and their characteristic appearance is shown in *Pl. 182, f. 2.* I do not consider it worth while to attempt to name or describe them.

The three species that I have ventured to describe are so unique and well preserved as well as so characteristic that I hope their publication may incite some experienced mycologist to delve in the field of fossil fungi which should prove to be a scientifically fruitful as well as delightful occupation.

It has been abundantly proven that we knew but little of the phylogeny of the vascular plants before their extinct ancestors were considered and the same should prove true in the case of the lower plants which are of so much more ancient a lineage.

THE JOHNS HOPKINS UNIVERSITY,
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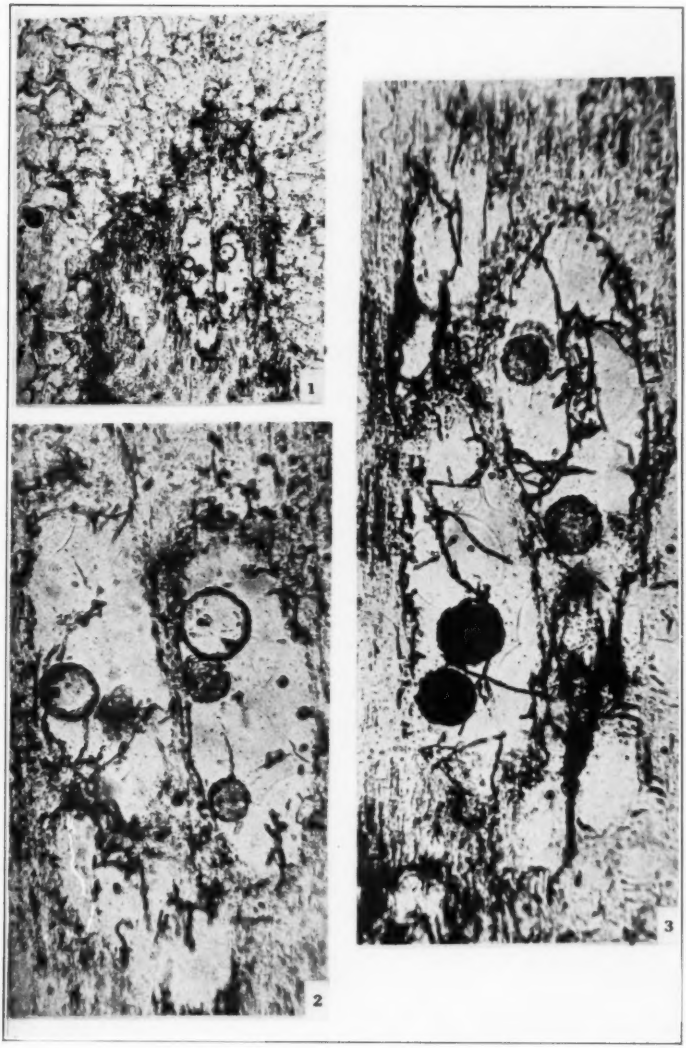
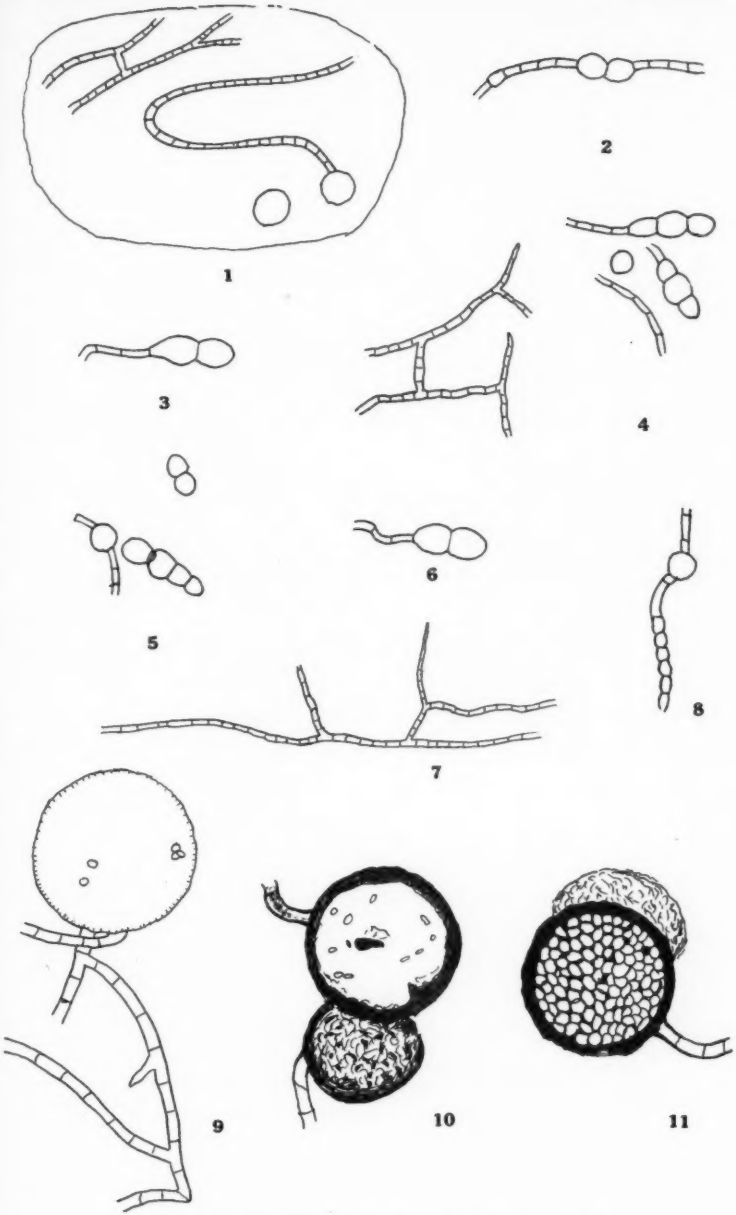
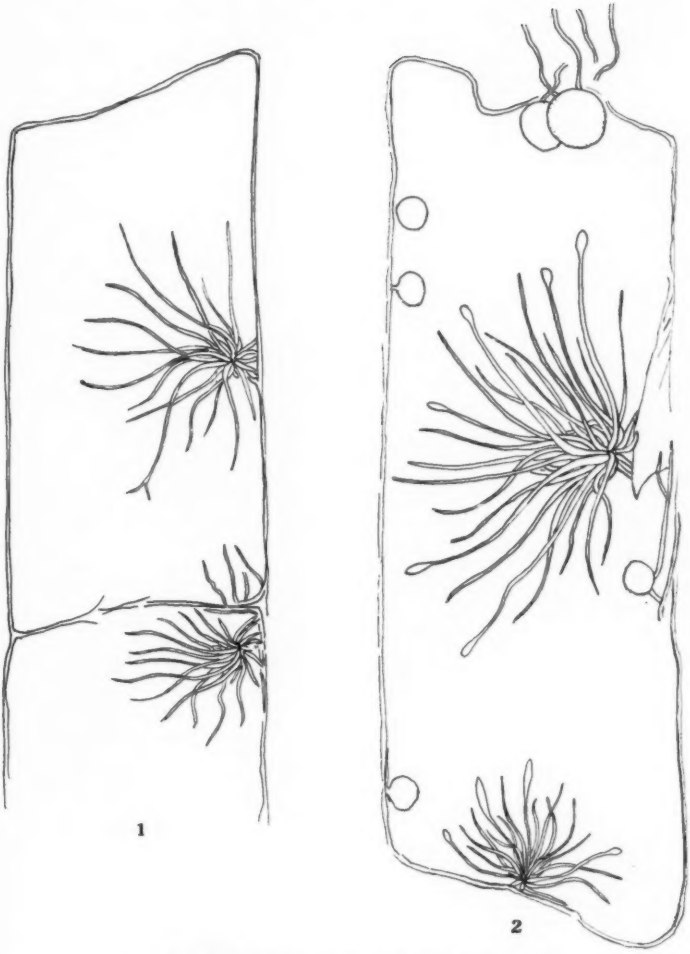


PERONOSPOROIDES PALMI BERRY



1–8. CLADOSPORITES OLIGOCAENICUM BERRY
9–11. PERONOSPOROIDES PALMI BERRY



CLADOSPORITES FASCICULATUS BERRY

EXPLANATION OF PLATES CLXXX–CLXXXII

PLATE CLXXX

Figs. 1–3. *Peronosporoides palmi* Berry. Showing mycelia, antheridia, and oögonia in tissues of *Palmoxylon cellulosum* Knowlton from the lower Oligocene of Bayou Pierre, Mississippi. Fig. 1, × 50; figs. 2 and 3, × 200.

PLATE CLXXXI

Figs. 1–8. *Cladosporites oligocaenicum* Berry. Showing mycelia, zygosporangia, and conidia in the tissues of *Palmoxylon cellullosum* Knowlton from the lower Oligocene of Bayou Pierre, Mississippi. × 400.

Figs. 9–11. *Peronosporoides palmi* Berry.

Fig. 9. Mycelium with oögonium. × 400.

Fig. 10. Antheridium and oögonium. × 400.

Fig. 11. Oögonium with oöspores and traces of collapsed antheridium. × 400.

PLATE CLXXXII

Figs. 1, 2. *Cladosporites fasciculatus* Berry. Showing mycelia and conidia in vessels of *Laurinoxylon* from Middle Eocene of Westmorland Bluff, Trinity River, Texas. × 400

LABORATORY TESTS ON THE DURABILITY OF AMERICAN WOODS—I.

FLASK TESTS ON CONIFERS

C. J. Humphrey

(With Plate 183)

Introduction

Our present knowledge of the relative durability of American woods has been, for the most part, derived from service or field tests carried out by engineers or agriculturalists. Certain of the larger wood users, such as railroads, telephone and telegraph companies, have for several years past kept records on the durability of ties, poles and other timbers as a basis for the selection of durable material or for determining the expediency of applying wood preservatives. Similar data have been secured through the experimental work of the United States Forest Service and the Agricultural Experiment Stations.

The conditions governing such tests can not be kept uniform or in any way put under control. Hence, even for a single species of timber, the data secured will be highly variable, depending upon the character of the soil, drainage, air and soil temperature, precipitation, atmospheric humidity, and any other factors which may influence the growth of wood-rotting fungi. Since environmental factors offer great variations between different regions of the United States, we can readily see why the natural durability of timber in warm, humid regions, for instance, frequently falls short of its resistance to decay in cooler, less moist localities.

The question of the presence or absence of certain of the more destructive species of fungi in a given locality also influences natural durability. In regions long free of forests the soil may, for instance, be comparatively free of wood-rotting fungi. The relative great abundance of decay-producing species and individuals in the tropics is one factor in the rapid deterioration of timber in those regions. It is but Nature's way in maintaining the proper

balance in plant life, for where trees develop luxuriantly they must also rot rapidly.

The manner and rate at which different species of fungi act on given kinds of wood is often highly variable, more or less a specific property of the fungus. Under natural conditions certain species seem exclusively or predominantly to attack conifers, while others confine their activities to hardwood (broadleaf) timber. Still others may attack almost exclusively hardwood trees in one region and conifers in another. In some cases this may be an apparent rather than a real condition, however, since our judgment as to the identity of a fungus rests upon the morphological characters of the fruit-bodies which it produces and it is an oft-observed fact that many decaying timbers fail to develop the fruiting stage of the organism at all.

LABORATORY TESTS ON DURABILITY

Comparatively few laboratory tests on the durability of timber are recorded either in European or American literature. The European continent, however, has few timber species compared with the great variety on the American side.

Through the activities of the United States Forest Service strength values and other physical properties of our commercial woods have been worked out, but this paper is the first of a series on the relative resistance which the different timbers offer toward different fungi. It is proposed to carry on the work from year to year, using various wood-rotting fungi and adding new kinds of timber as they are made available.

The work was begun about three years ago at the Forest Products Laboratory on material collected from all portions of the United States primarily for timber test purposes. Both heartwood and sapwood were secured whenever possible, but since the available material comprised in many cases only corners and slabs remaining after sawing out the specimens for strength tests it was not always possible to get everything desired. In the case of hemlocks, firs and spruces heartwood and sapwood are poorly differentiated as far as color changes go, the differences in physiological functions in the living trees, however, are just as marked as in

other species of timber. Wood classed as heartwood was always selected well within the sapwood ring.

The present paper comprises tests on 28 species of conifers and presents data only on single specimens of wood for three different test periods. As it consists in but one set of tests the figures should be considered as preliminary and indicative rather than final. Other tests now under way will throw further light on the question and when sufficient data have accumulated generalizations will become admissable. Due consideration to these facts should be given in interpreting durability values. Also, the fact that different samples of the same kind of wood show different durabilities, depending upon their physical, and possibly chemical, constitution must be kept in mind in establishing a true conception of the resistance which the woods offer to decay.

The very destructive and vigorous-growing fungus, *Lentinus lepideus* Fr., which is abundantly distributed on coniferous timber over practically the entire United States, was selected for this first series of tests on account of its very rapid growth and the vigor with which it is known to rot many species of conifers in nature. The culture was secured from a tissue transfer taken from a plant collected by the writer from a Douglas fir stump in Montana in 1910. The purity of the culture is unquestioned; it has produced typical, but, of course, reduced, fruit-bodies several times during the course of the tests (*Plate 183.*)

METHOD

All tests have been conducted in 2-liter Erlenmeyer flasks, plugged rather tightly with absorbent cotton, and then capped with thin muslin soaked in a dilute solution of mercuric chloride.

The flasks were prepared in triplicate, the original intention being to examine the first at the end of three months, the second after six months, and the third after nine months. Field work interrupted this schedule somewhat, as noted by the tables.

The test woods were identified and the logs marked with a stencil or paint in the forest by the various collectors. They were then shipped to the laboratory in a green condition and sawn as needed. The blocks for durability tests were cut $\frac{5}{8}$ by $\frac{5}{8}$ inch

square and 2 inches long from clear material, free of defects. In selecting heart and sapwood close attention was paid to getting representative material. In order to determine the actual loss in weight from decay, the blocks were dried in a steam-heated oven for 48 hours at a temperature of 100° C., or close around that point, and then weighed to the nearest .01 of a gram. On the completion of the tests the blocks were again oven-dried in a similar manner, the resulting weights compared with the original, and the percentage loss, based on the dry weight of the sound material calculated.

The flasks in which the experiments were carried out were prepared as follows: Culture blocks[1] from 1 to 2 inches long and of a diameter sufficient to go through the neck of a wide-mouth flask were cut from hemlock, boiled to saturation in tap water, and given a preliminary sterilization of several hours at about 10 pounds pressure in the autoclave. This was for the purpose of killing any latent fungi and of removing the excess water. On removing from the autoclave a layer of these blocks was placed in the bottom of each flask, resting on a layer of absorbent cotton[2] saturated with water. The test blocks, usually ten different species to a flask, were then inserted in a dry condition, taking care to keep them well off the wet cotton. Another layer of hemlock culture blocks was then added to about three-fourths of the height of the flask, this being surmounted by another wad of saturated absorbent cotton. The flasks were then tightly plugged with cotton and sterilized in the autoclave, without pressure, for periods of 45, 30, and 30 minutes, respectively, on three successive days.

After sterilization they were inoculated with a culture of *Lentinus lepideus*, growing on a bean pod, by emptying the bean directly into the flask. When inoculating wood cultures it is quite essential to use a generous quantity of infecting material.

The test blocks were grouped more or less according to their supposed durability, heartwood and sapwood samples in every

[1] The term "culture blocks" refers to the irregular hemlock blocks introduced into the flasks as a medium to support a vigorous growth of the fungus in order to secure a uniform and severe infection of the "test blocks."

[2] In later work the cotton has been omitted, as the test blocks often became too wet.

TABLE I

DURABILITY OF SAPWOOD AFTER 4 MONTHS' TEST[3]

[An asterisk (*) denotes that the blocks became too wet for a fair test.]

Kind of Wood	Flask No.	Oven-Dry Weight (Grams)		Loss		Remarks
		Before Test	After Test	Grams	Per Cent.	
Eastern hemlock	1	6.44	5.25	1.19	18.5	Considerably rotted.
Mountain hemlock	1	7.39	7.07	0.32	4.3*	
Western hemlock	4	7.87	5.67	2.20	28.0	Seriously rotted.
Engelmann spruce	4	6.35	4.51	1.84	29.0	Seriously rotted.
Sitka spruce	4	5.49	4.61	0.88	14.2*	
Red spruce	4	6.79	4.98	1.81	26.7	Rotted at ends.
White spruce	4	6.25	4.51	1.74	27.8	Seriously rotted.
Alpine fir	4	6.19	4.76	1.43	23.1	Seriously rotted.
Grand fir	4	7.30	6.90	0.4	5.5*	
Grand fir	4	5.98	4.58	1.40	23.4	Seriously rotted.
Noble fir	4	6.73	5.05	1.68	25.0	Seriously rotted.
Douglas fir	7	7.36	5.42	1.94	26.4	Seriously rotted.
European larch	4	7.16	6.44	0.72	10.0*	
Western yellow pine	1	6.65	5.03	1.62	24.4	Seriously rotted.
Lodgepole pine	1	6.80	5.37	1.43	21.0	Seriously rotted.
Longleaf pine	7	7.93	5.51	2.42	30.5	Seriously rotted.
Shortleaf pine	7	8.46	6.34	2.12	25.1	Seriously rotted in springwood.
Table mountain pine	1	7.33	6.69	0.64	8.7*	
Pitch pine	1	8.65	6.55	2.10	24.3	Seriously rotted.
White pine	1	4.12	3.06	1.06	25.7	Seriously rotted.
Sugar pine	1	5.11	3.94	1.17	22.9	Seriously rotted.
Western white pine	1	6.40	5.30	1.10	17.2	Considerably rotted.
White cedar	7	4.52	4.50	0.02	.. *	
Western red cedar	7	4.76	4.65	0.11	2.3*	
Port Orford cedar	7	6.52	5.23	1.29	19.8	Seriously rotted on three sides.
California juniper	7	9.50	6.81	2.69	28.3	Seriously rotted.
Western juniper	7	6.77	5.30	1.47	21.7	Seriously rotted.
Bigtree	7	7.94	7.72	0.22	2.8*	

case being tested in separate flasks. Each block was marked by writing its name and number on two faces with a soft heavy-leaded pencil. This system of marking has proven satisfactory and has been adopted for all work of this nature.

The flasks were inoculated on January 29, 1914. In about a month the contents were uniformly infected throughout. Flasks 11, 12, and 17, becoming contaminated with molds, were opened, the test blocks again oven-dried for 24 hours and new culture flasks prepared as before. All cultures were then kept in a glass case in the diffuse light of the laboratory. The temperature fluc-

[3] Data in this table and the following are based on single specimens of each sample of wood.

TABLE II

DURABILITY OF HEARTWOOD AFTER 4 MONTHS' TEST

[An asterisk (*) denotes that the blocks became too wet for a fair test.]

Kind of Wood	Flask No.	Oven-Dry Weight (Grams)		Loss		Remarks
		Before Test	After Test	Grams	Per Cent.	
Eastern hemlock	16	7.75	6.12	1.63	21.0	Considerably rotted.
Mountain hemlock	16	8.25	4.90	3.35	40.6	Seriously rotted.
Western hemlock	13	7.19	5.31	1.88	26.1	Seriously rotted.
Engelmann spruce	13	7.10	3.65	3.45	48.6	Friable when dry.
Sitka spruce	13	6.81	4.43	2.38	34.9	Seriously rotted.
Red spruce	13	6.89	4.80	2.09	30.3	Seriously rotted.
White spruce	13	6.20	4.11	2.09	33.7	Seriously rotted.
Alpine fir	13	6.22	3.73	2.49	40.0	Friable when dry.
Grand fir	13	7.23	5.04	2.19	30.3	Friable when dry.
Grand fir	13	5.93	2.79	3.14	53.0	Friable when dry.
Noble fir	13	7.44	5.11	2.33	31.3	Seriously rotted.
Douglas fir	10	7.12	4.73	2.39	33.6	Seriously rotted.
European larch	13	7.23	4.18	3.05	42.2	Seriously rotted.
Western yellow pine	16	7.11	5.84	1.27	17.9	Considerably rotted.
Lodgepole pine	16	6.74	5.75	0.99	14.7*	Considerably rotted.
Longleaf pine	10	10.62	10.58	0.04	0.4	Sound.
Shortleaf pine	10	11.51	10.70	0.81	7.0	Slightly rotted in springwood.
Table mountain pine	16	10.50	10.12	0.38	3.6	Slightly affected.
Pitch pine	16	10.69	10.44	0.25	2.3*	
Norway pine	16	8.02	8.02	0	0 *	
White pine	16	6.57	6.50	0.07	1.1*	
Sugar pine	16	5.95	5.10	0.85	14.3*	
Western white pine	16	7.14	6.45	0.69	9.7*	Considerably rotted.
White cedar	10	5.07	5.10	0	0	Sound.
Western red cedar	10	5.06	5.04	0.02	0.4*	
Port Orford cedar	10	7.15	7.06	0.09	1.3*	
California juniper	10	9.88	9.90	0	0	Sound.
Western juniper	10	6.15	6.11	0.04	0.7*	
Bigtree	10	8.10	8.04	0.06	0.7	Sound.

tuated considerably with the seasonal variations, usually around 20° C. in the winter and running up to 25 to 30° C. during the warm summer months.

Eighteen flasks in all were prepared. Flasks 1, 4, 7, 10, 13, and 16 were opened and examined on May 24, 1914, four months after inoculation; flasks 2, 5, 8, and 14 were opened on August 4, after six months' test; flasks 3, 6, 9, 15, and 18 after twelve months; flasks 11, 12, and 17, which were remade and inoculated on March 24, 1914, were examined on the same date the following year.

In computing the actual period of test it should be kept in mind that from three to four weeks are required to get a uniform infection after the inoculations are made. In the following tables,

TABLE III

DURABILITY OF SAPWOOD AFTER 6 MONTHS' TEST

[An asterisk (*) denotes that the blocks became too wet for a fair test.]

Kind of Wood	Flask No.	Oven-Dry Weight (Grams)		Loss		Remarks
		Before Test	After Test	Grams	Per Cent.	
Eastern hemlock	2	6.55	5.46	1.09	16.6*	Rotted at ends.
Mountain hemock	2	7.40	6.13	1.27	17.2*	Rotted at ends.
Western hemlock	5	8.55	7.52	1.03	12.0*	
Engelmann spruce	5	6.11	3.41	2.70	44.2	Well rotted.
Sitka spruce	5	5.74	2.68	3.06	53.3	Friable when dry.
Red spruce	5	6.43	3.39	3.04	47.3	Friable when dry.
White spruce	5	6.45	3.21	3.24	50.2	Friable when dry.
Alpine fir	5	6.15	3.40	2.75	44.7	Friable when dry
Grand fir	5	6.57	3.90	2.67	40.6	Well rotted.
Grand fir	5	5.95	3.64	2.31	38.8	Well rotted.
Noble fir	5	6.53	3.80	2.73	41.8	Well rotted.
Douglas fir	8	7.67	3.96	3.71	48.4	Friable when dry.
European larch	5	7.40	3.73	3.67	49.6	Friable when dry.
Western yellow pine	2	7.27	3.45	3.82	52.5	Well rotted.
Lodgepole pine	2	7.10	3.79	3.31	46.6	Well rotted.
Longleaf pine	8	8.78	3.85	4.93	56.1	Friable when dry.
Shortleaf pine	8	7.90	2.79	5.11	64.7	Friable when dry.
Table mountain pine	2	7.80	4.53	3.27	41.9	Well rotted in springwood.
Pitch pine	2	8.92	7.60	1.32	14.8*	
White pine	2	4.20	2.00	2.20	52.4	Friable when dry.
Sugar pine	2	5.11	2.31	2.80	54.8	Friable when dry.
Western white pine	2	8.10	4.45	3.65	45.1	Well rotted.
White cedar	8	4.56	4.07	0.49	10.7	Well rotted on sap side—two-fifths heartwood.
Western red cedar	8	4.86	1.96	2.90	59.7	Friable when dry.
Port Orford cedar	8	6.20	3.85	2.35	37.9	Well rotted at ends.
California juniper	8	9.59	8.44	1.15	12.0*	
Western juniper	8	6.65	3.40	3.25	48.9	Friable when dry.
Bigtree	8	8.39	5.24	3.15	37.5	Well rotted in springwood.

however, the test period is considered as beginning with the date of inoculation.

Tables I to VI present the essential data, giving the loss in weight after the different test intervals, together with notes on the condition of the test blocks.

In Table VII the preceding tables are summarized, averages being given for both the heartwood and sapwood of hemlocks, spruces and firs and for the sapwood of the white and hard pine groups. Where the test blocks were too wet they have been marked by an asterisk and have been excluded from all averages.

TABLE IV

DURABILITY OF HEARTWOOD AFTER 6 MONTHS' TEST

[An asterisk (*) denotes that the blocks became too wet for a fair test.]

Kind of Wood	Flask No.	Oven-Dry Weight (Grams)		Loss		Remarks
		Before Test	After Test	Grams	Per Cent.	
Western hemlock	14	7.14	3.30	3.84	53.8	Friable when dry.
Engelmann spruce	14	7.25	3.55	3.70	51.0	Friable when dry.
Sitka spruce	14	6.29	3.60	2.69	42.8	Friable when dry.
Red spruce	14	6.84	2.90	3.94	57.6	Friable when dry.
White spruce	14	6.13	3.20	2.93	47.9	Friable when dry.
Alpine fir	14	6.75	3.55	3.20	47.4	Friable when dry.
Grand fir	14	7.04	3.85	3.19	45.3	Friable when dry.
Grand fir	14	5.65	2.86	2.79	49.4	Friable when dry.
Noble	14	7.87	4.85	3.02	38.4	Friable when dry.
European larch	14	10.04	7.48	2.56	25.5	Well rotted in spring-wood.

In drawing conclusions from the above data the moisture condition of the test blocks should be given due weight. Such as became obviously too wet for decay to progress at its maximum rate have been indicated, but certain of the other blocks may have varied around their optimum sufficiently to influence the results somewhat. There is a strong indication that certain of the woods vary in their hygroscopic properties, and would thus absorb more moisture in a given time than other woods placed under similar conditions in the same flasks.

In order to assist toward a proper conception of the prevailing moisture condition the records made at the time of opening the flasks are presented as follows:

Flasks 11, 12, 16, and 17 were undeniably too wet. The results on flask 17 have not been used and flasks 11 and 12 have only been employed insofar as they appear of some value in forming a tentative estimate of durability.

In flasks 1, 2, 4, 7, 8, 9, 10, and 18 the moisture conditions were fairly good but rather in excess of the optimum.

Flasks 3, 5, 6, 13, 14, and 15 were in excellent condition, flask 13 apparently being the best of all.

In flask 10 the blocks of white cedar and California juniper were lying close to the top and were only slightly overgrown.

The growth of the fungus was very luxuriant in all and the

TABLE V

DURABILITY OF SAPWOOD AFTER 12 MONTHS' TEST

[An asterisk (*) denotes that the blocks became too wet for a fair test.]

Kind of Wood	Flask No.	Oven-Dry Weight (Grams)		Loss		Remarks
		Before Test	After Test	Grams	Per Cent.	
Eastern hemlock	3	7.40	2.39	5.01	67.7	Friable when dry.
Mountain hemlock	3	8.08	2.47	5.61	69.4	Friable when dry.
Western hemlock	6	7.95	2.41	5.54	69.7	Friable when dry.
Engelmann spruce	6	6.91	2.20	4.71	68.2	Friable when dry.
Sitka spruce	6	5.84	1.84	4.00	68.5	Friable when dry.
Red spruce	6	6.21	2.00	4.21	67.8	Friable when dry.
White spruce	6	7.26	1.78	5.48	75.5	Friable when dry.
Alpine fir	6	5.95	2.05	3.90	65.5	Friable when dry.
Grand fir	6	6.58	2.52	4.06	61.7	Friable when dry.
Grand fir	6	6.37	1.93	4.44	69.7	Friable when dry.
Noble fir	6	6.52	2.04	4.48	68.7	Friable when dry.
Douglas fir	9	7.52	2.37	5.15	68.5	Friable when dry.
European larch	6	7.16	2.11	5.05	70.5	Friable when dry.
Western yellow pine	3	8.18	2.38	5.80	70.9	Friable when dry.
Lodgepole pine	3	7.13	2.30	4.83	67.7	Friable when dry.
Longleaf pine	9	8.13	2.49	5.64	69.4	Friable when dry.
Shortleaf pine	9	9.57	3.00	6.57	68.7	Friable when dry.
Table mountain pine	3	8.00	2.40	5.60	70.0	Friable when dry.
Pitch pine	3	9.60	2.75	6.85	71.4	Friable when dry.
White pine	3	4.75	1.47	3.28	69.1	Friable when dry.
Sugar pine	3	5.18	1.67	3.51	67.8	Friable when dry.
Western white pine	3	8.18	3.15	5.03	61.5	Friable when dry.
White cedar	9	6.63	6.12	0.51	7.7*	Slightly rotted—two-fifths heart.
Western red cedar	9	4.76	3.05	1.71	35.9*	Seriously rotted at ends.
Port Orford cedar	9	6.93	2.30	4.63	66.8	Friable when dry.
California juniper	9	9.30	5.78	3.52	37.9*	Well rotted at ends.
Western juniper	9	7.21	6.00	1.21	16.8*	Considerably rotted.
Bigtree	9	8.38	3.10	5.28	63.0	Friable when dry.

hemlock culture blocks were for the most part thoroughly rotted except as they were too wet, particularly in the bottom of the flasks in contact with the wet cotton.

For the sapwood of 19 species which were in good condition for decay we find an average loss of 24.4 per cent. in 4 months. The average for hemlocks, spruces, and firs (including Douglas fir) was 24.9 per cent. It is thus seen that very little difference exists in the durability of the sapwood of the species tested. An average for the corresponding heartwoods is of no value, on account of the wide differences shown, except for hemlocks, spruces and firs, which average 34.8 per cent. loss. The apparent difference in resistance of heartwood and sapwood in these latter genera, is

TABLE VI

DURABILITY OF HEARTWOOD AFTER 12 MONTHS' TEST

[An asterisk (*) denotes that the blocks became too wet for a fair test.]

Kind of Wood	Flask No.	Oven-Dry Weight (Grams)		Loss		Remarks
		Before Test	After Test	Grams	Per Cent.	
Eastern hemlock	18	7.85	3.17	4.68	59.6	Friable when dry.
Mountain hemlock	18	8.61	3.08	5.53	64.2	Friable when dry.
Western hemlock	15	7.94	3.08	4.86	61.2	Friable when dry.
Engelmann spruce	15	7.23	2.27	4.96	68.6	Friable when dry.
Sitka spruce	15	4.33	1.63	2.70	62.4	Friable when dry.
Red spruce	15	7.07	2.30	4.77	67.5	Friable when dry.
White spruce	15	5.62	1.70	3.92	69.8	Friable when dry.
Grand fir	15	7.10	2.12	4.98	70.1	Friable when dry.
Noble fir	15	7.53	2.25	5.28	70.1	Friable when dry.
Douglas fir	11	7.43	5.34	2.09	28.1*	Seriously rotted at ends.
European larch	15	7.88	4.50	3.38	42.9	Well rotted.
Western yellow pine	18	7.60	3.35	4.25	55.9	Friable when dry.
Lodgepole pine	18	6.93	2.47	4.46	64.4	Friable when dry.
Longleaf pine	12	11.42	5.59	5.83	51.1	Friable when dry.
Shortleaf pine	11	12.25	9.72	2.53	20.7	Seriously rotted in summer wood.
Table mountain pine	18	10.22	6.17	4.05	39.6	Friable when dry.
Pitch pine	18	10.02	8.93	1.09	10.9*	Considerably rotted.
Norway pine	18	8.00	2.45	5.55	69.4	Friable when dry.
White pine	18	6.71	6.12	0.59	8.8	Slightly rotted.
Sugar pine	18	6.06	2.55	3.51	57.9	Friable when dry.
Western white pine	18	7.14	4.85	2.29	32.1*	Well rotted at ends.
White cedar	12	5.40	5.11	0.29	5.4*	Slightly rotted at ends.
Western red cedar	11	5.16	4.06	1.10	21.3*	Seriously rotted at ends.
Port Orford cedar	11	7.81	6.05	1.76	22.6*	Seriously rotted at ends.
California juniper	12	10.66	10.31	0.35	3.3	Slightly affected.
Western juniper	11	5.58	4.73	0.85	15.2*	Seriously rotted ta one end.
Bigtree	11	7.07	4.59	2.48	35.1	Seriously rotted.

considered as having no special significance beyond the fact that little discrimination can be made between them or between the different species represented.

For the six months' period the average loss in the sapwood of 21 species (exclusive of white cedar) was 48 per cent., while the average loss in the heartwood of hemlocks, spruces and firs was 49.6 per cent. These figures show that decay progressed at the same rate during the second three months as during the first three (allowing one month after inoculation for the fungus to become uniformly distributed throughout the flasks).

Sapwood tests over a 12 months' interval resulted in complete decay for all species (23) which were not too wet. The average loss for all was 68.2 per cent. and for hemlocks, spruces and firs

TABLE VII

PER CENT. LOSS IN DRY WEIGHT FOR THE DIFFERENT TEST PERIODS

[An asterisk (*) denotes that the blocks became too wet for a fair test.]

Kind of Wood	Sapwood			Heartwood		
	4 Months	6 Months	12 Months	4 Months	6 Months	12 Months
Hemlocks	23.3	—	68.9	29.2	53.8	61.7
Spruces	27.5	48.7	69.7	36.2	49.8	67.1
Firs	23.8	41.5	66.4	38.9	45.1	70.1
White pines	21.9	50.8	66.1	—	—	—
Hard pines	25.1	52.4	69.7	—	—	—
Western yellow pine	24.4	52.5	70.9	17.9	—	55.9
Lodgepole pine	21.0	46.6	67.7	14.7*	—	64.4
Longleaf pine	30.5	56.1	69.4	0.4	—	51.1
Pitch pine	24.3	14.8*	71.4	2.3*	—	10.9*
Norway pine	—	—	—	0 *	—	69.4
Shortleaf pine	25.1	64.7	68.7	7.0	—	20.7
Western white pine	17.2	45.1	61.5	9.7*	—	32.1*
Sugar pine	22.9	54.8	67.8	14.3*	—	57.9
Table mountain pine	8.7*	41.9	70.0	3.6	—	39.6
White pine	25.7	52.4	69.1	1.1*	—	8.8
European larch	10.0*	49.6	70.5	42.2	25.5	42.9
Douglas fir	26.4	48.4	68.5	33.6	—	28.1*
Bigtree	2.8*	37.5	63.0	0.7	—	35.1
Port Orford cedar	19.8	37.9	66.8	1.3*	—	22.6*
White cedar	0 *	10.7	7.7*	0	—	5.4*
Western red cedar	2.3*	59.7	35.9*	0.4*	—	21.3*
California jun per	28.3	12.0*	37.9*	0	—	3.3
Western juniper	21.7	48.9	16.8*	0.7*	—	15.2*

68.4 per cent. The corresponding loss in the heartwood of the latter genera (exclusive of Douglas fir) was 65.9 per cent. In all of these specimens the wood was so thoroughly rotted that it could be pulverized between the fingers.

The 12 months' test on heartwood of the remaining species brings out considerable differences in durability, ranging from 3.3 per cent. loss in California juniper to 69.4 per cent. in Norway pine. White pine was affected but little (8.8 per cent.), while sugar pine was seriously rotted (57.9 per cent.). Lodgepole pine (64.4 per cent.) fell in the class with hemlocks, spruces and firs. The specimen of longleaf pine, which did not appear very highly resinous, did not prove as resistant (51.1 per cent.) as shortleaf pine (20.7 per cent.), which was of a good grade. Table mountain

pine, a close relative of the shortleaf, and apparently quite resinous, lost 39.6 per cent. The durability of bigtree wood (35.1 per cent.) did not fully meet expectations. Other interesting features of the tests were as follows:

The sapwood of white cedar proved highly durable, standing out in marked contrast to that of any other species tested.

The sapwood of Port Orford cedar, bigtree, western red cedar, junipers, and hard pines was very susceptible to decay.

The sapwood of Douglas fir fell in the same class as the true spruces, firs, and hemlocks.

The heavy, hard, yellowish heartwood of California juniper was considerably more durable than the softer, reddish heartwood of western juniper.

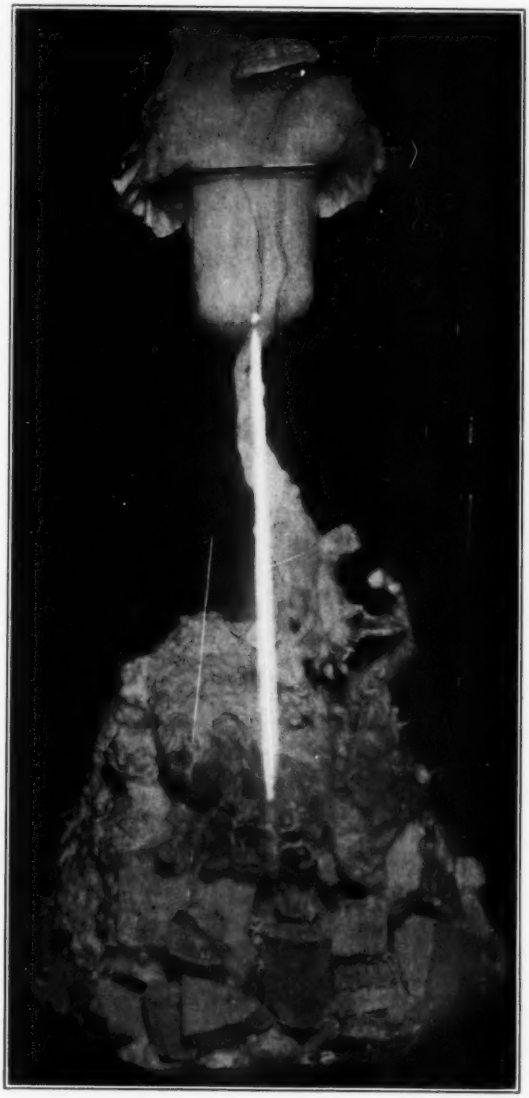
Further tests on the heartwood of such species as Port Orford cedar, white cedar, western red cedar, western juniper, Douglas fir, pitch pine, and western white pine are necessary before safe comparisons can be made.

The common names for woods listed above are, for the most part, those recommended by G. B. Sudworth of the United States Forest Service. The corresponding botanical names, source and laboratory number are as follows:

White cedar,	*Thuja occidentalis* L.	Wis.	124
Western red cedar,	*Thuja plicata* Don.	Mont.	224–8
Bigtree,	*Sequoia washingtoniana* (Winsl.) Sudw.	Cal.	40
Alpine fir,	*Abies lasiocarpa* (Hook.) Nutt.	Colo.	15–1
Grand "	*Abies grandis* Lindl.	Mont.	224–16 10–9–30
Noble "	*Abies nobilis* Lindl.	Wash.	77
Eastern hemlock,	*Tsuga canadensis* (L.) Carr.	Tenn.	226–9
Western "	*Tsuga heterophylla* (Raf.) Sarg.	Mont.	136
Mountain "	*Tsuga mertensiana* (Bong.) Carr.	Wash.	13–4
California juniper,	*Juniperus californica* Carr.	Cal.	142
Western "	*Juniperus occidentalis* Hook.	Cal.	121
European larch,	*Larix europaea* D. C.	Wis.	126
Western yellow pine,	*Pinus ponderosa* Laws.	Mont.	224–21
Lodgepole "	*Pinus contorta* Loud.	Mont.	10–2
Longleaf "	*Pinus palustris* Mill.	La.	176–38
Pitch "	*Pinus rigida* Mill.	Tenn.	136
Norway "	*Pinus resinosa* Ait.	Wis.	127
Shortleaf "	*Pinus echinata* Mill.	Ark.	203–1
Western white "	*Pinus monticola* Dougl.	Mont.	224–2
Sugar "	*Pinus lambertiana* Dougl.	Cal.	122

Table mountain pine, *Pinus pungens* Michx. f.		Tenn.	226–80
White	" *Pinus strobus* L.	Wis.	120
Port Orford cedar, *Chamaecyparis lawsoniana* (Murr.) Parl.		Oreg.	98
Douglas fir, *Pseudotsuga taxifolia* (Lam.) Britt.		Cal.	38–6–2
Engelmann spruce, *Picea engelmanni* Engelm.		Colo.	15–25
Red	" *Picea rubens* Sarg.	Tenn.	226–84
Sitka	" *Picea sitchensis* (Bong.) Trautv. & Mayer	Wash.	13–7
White	" *Picea canadensis* (Mill.) B. S. P.	N. H.	60

INVESTIGATIONS IN FOREST PATHOLOGY, BUREAU OF PLANT INDUSTRY, IN COOPERATION WITH THE FOREST PRODUCTS LABORATORY, MADISON, WISCONSIN.



TEST FLASK WITH SPORULATING FRUIT-BODY OF *LENTINUS LEPIDEUS* GROWING UP THROUGH COTTON PLUG AND PUSHING OFF THE MUSLIN CAP. CULTURE ABOUT 9 MONTHS OLD

THE EARTH-INHABITING SPECIES OF ASCOBOLUS

FRED J. SEAVER

(WITH PLATE 184, CONTAINING 8 FIGURES)

Most of the species of the genus *Ascobolus,* which genus is characterized by the beautiful violet color of the spores, occur on the dung of animals of various kinds. Those forms which occur on other substrata are the exception rather than the rule. A few species occur on damp soil and these are the species which are treated in the present paper.

Of the earth-inhibiting species of *Ascobolus,* one species, *Ascobolus carbonarius* P. Karst. has been frequently collected in North America. In 1905 a second species was collected by the writer on damp soil along the banks of the Iowa River. This species was referred to *Ascobolus viridis* Curr. Since that time, the same species has been frequently collected on soil in New York State. Dodge in his morphological studies of the Ascobolaceae has noted the difference in the spores of the American and European specimens and has considered the American plants a possible variety of the European species. Comparative study of the two forms has convinced the writer that they represent two distinct species. The spores of the European plants are a third larger than those of the American and have an entirely different form as shown in the accompanying illustrations. The American plants are therefore redescribed below as *Ascobolus geophilus.*

In August, 1914, a species of *Ascobolus* was collected on damp soil in woods near Yonkers, New York, which was taken to be *Ascobolus viridis* of American authors. The spores however were almost globose. At first, this was thought to be only an extreme variation of the common species. During September of the same year, similar plants were collected in considerable quantity on Staten Island where they grew on damp soil on the bank of a little pond. In all of these plants the mature spores would pass as globose. The young spores, however, are found to be

slightly ellipsoid. In addition to their form the spores when mature are covered with crevices which are so deep as to give to the outside of the spore a peculiar ragged appearance. As they mature, the spores become so dark that they are almost opaque. This species is also regarded as distinct and described below as *Ascobolus subglobosus.*

In June, 1914, still another earth form had been collected which differed from any listed above in the fact that the apothecia were entirely white except the hymenium, which became darkened by the maturing spores. The spores and asci of this species were identical, so far as the writer could determine, with those of *Ascobolus carbonarius* but both color and habitat seemed to distinguish it from that species. *Ascobolus carbonarius* is restricted to burned places while this species grew on soil where there was no trace of fire. It may be that these plants represent only an albino form of *Ascobolus carbonarius* and that the white color is due to the fact that the plants have grown on an unfavorable substratum. The form is here listed as *Ascobolus albinus.* The following is a synopsis of the earth-growing species of *Ascobolus* as at present known for North America.

ASCOBOLUS Pers. in L. Syst. Nat. 1461. 1791.

Apothecia sessile, or stipitate, superficial or partially immersed in the substratum, externally smooth or pilose; hymenium concave, plane or convex; substance soft, fleshy or waxy, usually greenish; asci cylindric to clavate or subovoid, 4–8-spored; spores becoming blue or purple, fading to brown or blackish, ellipsoid to subglobose; smooth or rough; spore-roughenings very variable often consisting of crevices or cracks which give to the surface of the spore a reticulate appearance; paraphyses slender and usually adhering together in fascicles or clumps.

Type species, *Peziza stercoraria* Bull.

Plants restricted to burned areas.	1. *A. carbonarius.*
Plants not restricted to burned areas.	
Apothecia white, spores verrucose.	2. *A. albinus.*
Apothecia greenish to blackish, spores reticulate.	
Spores ellipsoid.	3. *A. geophilus.*
Spores subglobose.	4. *A. subglobosus.*

1. ASCOBOLUS CARBONARIUS P. Karst, Fungi Fennici *463*. 1866

Ascobolus atrofuscus Phill. & Plow. Grevillea **2**: 186. 1873.
Ascobolus carbonicola Boud. Bull. Bot. Soc. Fr. **24**: 310. 1877.
Phaeopezia Nuttallii Ellis & Ev. N. Am. Fungi *2908*. 1893.

Apothecia scattered or more often crowded into congested masses several cm. in diameter, at first globose or subglobose, expanding and becoming scutellate, reaching a diameter of 4–5 mm., externally yellowish-green, becoming dark-brown, coarsely granular; hymenium plane or nearly plane with the margin slightly elevated, at first greenish, becoming dotted over with the ends of the protruding asci, gradually becoming darker, finally almost black; asci clavate, gradually tapering below into a long slender stem-like base, reaching a length of 200–225 μ and a diameter of 23–27 μ, 8-spored; spores 1-seriate or crowded together so as to become partially 2-seriate, ellipsoid with the ends rather strongly narrowed, thick-walled, the ends often capped with a thickening of the epispore, giving the spore a truncate appearance, hyaline, becoming violet, finally brown or brownish-black, 20–24 $\times$ 12–14 μ including roughenings; spore-roughenings taking the form of wart-like projections, the spaces between appearing lighter, giving rise to reticulate markings; paraphyses about 3 μ in diameter and scarcely thickened above, embedded in greenish-yellow mucilaginous substance.

On burnt places and on charcoal beds.

TYPE LOCALITY: Finland.

DISTRIBUTION: New York to Iowa and West Virginia.

ILLUSTRATION: Ann. Sci. Nat. V. **10**: *pl. 5, f. 4* (as *Ascobolus viridis* Curr.); Bull. Lab. Nat. Hist. State Univ. Iowa **6**: *pl. 29, f. 1;* Bull. Torrey Club **39**: *pl. 10, f. 9, 10, 11.*

EXSICATTI: Ellis & Ev. N. Am. Fungi *2908* (as *Phaeopezia Nuttallii* Ellis & Ev.).

2. **Ascobolus albinus** sp. nov.

Apothecia gregarious, at first subglobose, expanding and becoming scutellate, reaching a diameter of 4–5 mm., externally pure white, minutely rough; hymenium plane or nearly plane, at first whitish, becoming darkened by the maturing spores; asci cylindric or subcylindric, 8-spored, reaching a length of about 200 μ and a diameter of about 25 μ; spores at first obliquely 1-seriate, becoming 2-seriate or irregularly crowded, ellipsoid, be-

coming purple then brown, 20–26 × 12 μ, rough; spore roughenings consisting of minute warts; paraphyses very slender, hyaline.

On damp soil in woods.

TYPE LOCALITY: Woods, near Yonkers, New York.

DISTRIBUTION: Known only from the type locality.

3. **Ascobolus geophilus** sp. nov.

Apothecia scattered, gregarious, or more rarely crowded, at first subglobose, expanding, becoming scutellate to discoid, reaching a diameter of 5 mm., externally greenish-yellow, furfuraceous to nearly smooth; hymenium plane or slightly concave, similar in color to the outside of the apothecium, roughened by the protruding asci and becoming darker as the spores mature, finally almost black; asci clavate, gradually tapering below into a stem-like base, reaching a length 200–250 μ and a diameter of 15–18 μ, 8-spored but often with only 4 spores developed; spores 1-seriate, becoming 2-seriate or irregularly crowded, ellipsoid, at first hyaline, becoming violet, then brown, 22–25 × 12–13 μ, becoming rough; spore-roughenings consisting of verrucose markings and reticulations, the reticulations consisting of light lines which give rise to an irregular net-work; paraphyses very slender, sparingly branched, reaching a diameter of 2 μ, scarcely enlarged above, embedded in golden-yellow mucilaginous substance.

On damp soil.

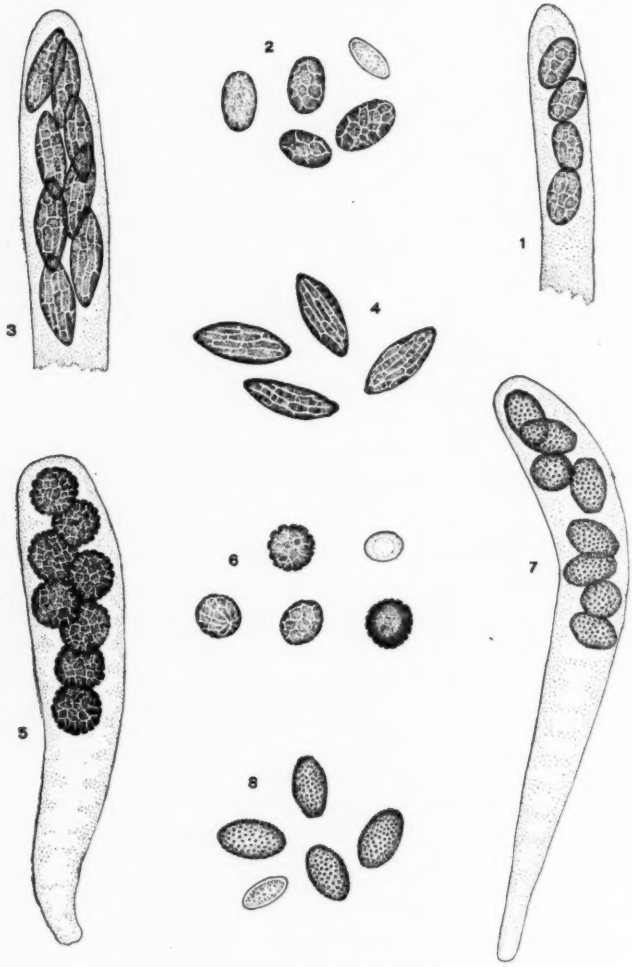
TYPE LOCALITY: Europe.

DISTRIBUTION: New York to Iowa.

ILLUSTRATIONS: Bull. Lab. Nat. Hist. State Univ. Iowa **6**: *pl. 30, f. 1.*

4. **Ascobolus subglobosus** sp. nov.

Apothecia gregarious or thickly crowded, at first nearly globose, expanding and becoming almost discoid, reaching a diameter of 3–5 mm., externally smooth, greenish-yellow; hymenium plane, convex or irregularly convolute, at first similar in color to the outside of the apothecium, becoming dotted over with the ends of the protruding asci, finally entirely black; asci subcylindric to clavate, gradually tapering below into a stem-like base, 8-spored; spores at first 1-seriate, becoming crowded and partially 2-seriate as they mature, at first hyaline and containing one oil-drop which is often surrounded by numerous smaller ones, becoming violet, finally almost black, and opaque becoming rough, reaching a diameter of 18–20 μ or 18 × 20 μ; spore-roughenings taking the form



SPECIES OF ASCOBOLUS

of numerous vein-like reticulations, which consist apparently of crevices, the spaces between the crevcies giving rise to prominent projections visible about the periphery of the spore, the spaces between appearing as notches, giving the spore a very ragged appearance; paraphyses scarcely enlarged above, embedded in golden-yellow, mucilaginous substance.

On damp soil in woods and on the margin of a small pond.

TYPE LOCALITY: Woods near Yonkers, New York.

DISTRIBUTION: Woods near Yonkers and Staten Island, New York.

NEW YORK BOTANICAL GARDEN.

EXPLANATION OF PLATE CLXXXIV

All drawings are made with the aid of the camera lucida to a common scale. 1–2, *Ascobolus geophilus* Seaver; 3–4, *Ascobolus viridis* Curr.; 5–6, *Ascobolus subglobosus* Seaver; 7–8, *Ascobolus carbonarius* P. Karst.

NEW OR NOTEWORTHY SPECIES OF FUNGI[1]

JOHN DEARNESS

DISCOMYCETES

1. **Mollisia apiophila** sp. nov.

Apothecia 0.3–1 mm. when fresh, hardly visible to the naked eye when dry, flesh-color, subsessile, turbinate, height nearly equaling width; cells of hypothetical layer elongate, septate, 3–4 μ across, of ectal layer round to angular, thin-walled, 10–12 μ. Asci with paraphyses making a yellowish-hyaline stratum 75–80 μ, p. sp. 45–52 $\times$ 10–12 μ. Sporidia biseriate, 2–4 guttulate, hyaline, naviculate, 16–18 $\times$ 4–6 μ.

On preceding season's stems of *Apios tuberosa* Moench. Limited to these stems and often associated with another thin sessile *Mollisia* having much smaller sporidia and not limited to *Apios*. London, Ont., *J. Dearness 3943;* observed annually, August and September.

2. **Belonidium Macounii** sp. nov.

Apothecia cyathiform to ureceolate, sessile, dark-brown, 1 mm. in diameter, gregarious, sometimes cespitose. Asci hyaline, cylindrical, 90–96 $\times$ 7 μ, overtopped by the hyaline paraphyses, which are enlarged at the tips. Sporidia elongate, hyaline, 3-septate, 20–30 $\times$ 3 μ, in more than a single series.

On dead stems of *Spiraea Menziesii* Hook., Vancouver Island, May–June, 1915, *John Macoun.*

PYRENOMYCETES

3. **Laestadia biennis** sp. nov.

Perithecia epiphyllous, black, subglobose, perforate at or near the summit, 180–360 μ. Asci fusoid, sessile, aparaphysate, 40–50 $\times$ 7–9 μ. Sporidia sub-biseriate, nucleate near each end or guttulate, continuous, oblong-elliptic, 8–11 $\times$ 3–4 μ.

[1] Examined cotypic material or microscopic mounts of the following species will be sent to the Victoria Memorial Museum, Ottawa, Canada, the National Herbarium, Washington, D. C., and the New York Botanical Garden.

On the preceding season's basal leaves of *Solidago juncea* Ait., near Byron, Ontario, *J. Dearness 3088,* collected in 1904 and observed annually since until date.

In autumn the infected leaves are extensively discolored, red-brown to blackish-brown, usually the entire right or left half, seldom both sides of the midrib. Black, subglobose "sclerotia," mostly about 140 μ in depth and 240 μ in breadth, are thickly scattered, 3 or 4 to the sq. mm., over most of the darkly discolored area, prominent on the upper side but visible beneath, containing a white mass of coarse parenchymatic cells about 7 μ.

Specimens wintered out of doors began to show asci by the middle of April. Sporidia issued freely in sections in water in the latter half of May. This will be distributed in Fungi Columbiani.

4. **Trichosphaeria breviseta** sp. nov.

Perithecia black, crowded, appearing to the naked eye as a continuous stratum, 3 but not quite 4 to the lineal mm., globose-conic; bristles 15 to 20 μ, usually limited to the basal half of the perithecia. Asci linear, 50–75 μ, shorter than the abundant paraphyses. Sporidia uniseriate, nucleate at each end, hyaline, 6–7 $\times$ 3–3.5 μ.

On rotten coniferous wood, Victoria, B. C., April, 1915, *John Macoun.*

5. **Diaporthe Euonymi** sp. nov.

(In Euporthe). Stroma widely effused, sometimes surrounding the stem or in small patches containing one or a few contiguous perithecia, whitening the substance of the bark and causing it to adhere firmly to the wood which is marked by a black circumscribing line. Perithecia single or in small groups, 2 to 4, not circinating, partly sunk in the wood, globose, 270–500 μ in diameter; the cylindric to conic ostiola 100 μ thick, erumpent through the epidermis, 100–130 μ, in richly fertile parts closely ranked and appearing to the naked eye as black parallel lines. Asci cylindrical to fusoid, sessile, 8-spored, paraphysate, 60–75 $\times$ 11–15 μ. Sporidia obliquely uniseriate or sub-biseriate, oblong-elliptic, not constricted, septum distinct, 12–15 $\times$ 6–7 μ.

On dead stems of *Euonymus atropurpureus* Jacq., Delaware, Ontario, June, 1913, *J. H. Bowman.*

6. **Diaporthe Macounii** sp. nov.

Stromata numerous, minute, 0.5–0.8 mm., raising the substellately ruptured epidermis into flattish pustules, sometimes deciduous, exposing the yellowish cortex and thus mottling the affected twigs, not visible on the interior side of the bark although the subjacent wood is perceptibly darkened to the pith; no black circumscribing line in either cortex or wood. Perithecia single or 2–6 in a stroma, 90–275 μ; ostiola very short, not visible under lens. Asci fusoid, 30–35 $\times$ 6–7 μ. Sporidia irregularly biseriate, hyaline, 8–9 $\times$ 2.5 μ, nucleate, very obscurely uniseptate, the cells sometimes separating at the septum, the lower one smaller.

On dead stems of *Spiraea Menziesii* Hook., Vancouver Island, May, 1915, *John Macoun*.

7. DIAPORTHE COLUMBIENSIS Ellis & Ev. Proc. Acad. Nat. Sci. Phil. **1890**: 233. 1890.

In the original description the host was said to be undetermined. Dr. Macoun sends a *Diaporthe* on *Nuttallia cerasiformis* T. & G., collected near Victoria, B. C., April, 1915, which agrees with the description of *D. columbiensis* E. & E.

8. **Didymosphaeria Housei** sp. nov.

Perithecia scattered, blackish-brown, raising the epidermis into small subglobose pustules 0.3 mm.; ostiola very short, almost obsolete. Asci cylindrical, short-stipitate, 65–72 $\times$ 5–6 μ, paraphysate. Sporidia smoky-brown, 1-septate, slightly constricted, compactly uniseriate, 8–9 $\times$ 4–4.5 μ, much smaller than in *Didymosphaeria Ceanothi* Cooke & Hark.

On dead stems of *Ceanothus americanus* L., Albany, New York, January, 1915, *H. D. House*.

9. **Metasphaeria Macounii** sp. nov.

Perithecia nearly black, thinly scattered, flattened at the base, globose-conic, semi-immersed in the wood, oftener only the stout conic ostiola visible, conspicuously punctating the whitened areas of the decorticated stems, large, 0.5–.75 mm. in diameter. Asci linear-cylindric, 135–170 $\times$ 7 μ, abundantly paraphysate. Sporidia hyaline, strictly uniseriate, rounded at the ends, endochrome 3-divided, 16–22 $\times$ 6–7 μ.

On dead, decorticated stems of a species of wild rose (*Rosa* sp.), Vancouver Island, B. C., June, 1915, *John Macoun*.

FUNGI IMPERFECTI

10. **Placosphaeria cornicola** sp. nov.

The affected leaves, or the affected areas thereof, turn bright red, then gradually become cinnamon color, mottled on both sides with the numerous black stromata. Stromata effused, less than 1 sq. mm., tending to become confluent. Pycnidia epiphyllous, 1–9 or more in a stroma, 40–60 μ in diameter, their positions marked by a pale-bordered perforation or stoma. Spores hyaline, oblong, 2.5–5 $\times$ 0.5–0.75 μ.

Attacking living leaves of *Cornus Nuttallii* Aud., Vancouver Island, B. C., September, 1914, *John Macoun*.

11. **Sphaeropsis lineata** Ellis and Dearness, sp. nov.

Pycnidia separate but so close together as to seem to the naked eye to be in continuous parallel lines, hemispheric, closely invested by the ruptured epidermis, 160–360 μ; ostiola short, black with a white center visible under the lens. Conidia brown, oblong-elliptic, rounded at the ends, a median nucleus often giving under low magnification the appearance of a septum, 19–24 $\times$ 9–12 μ, on basidia of about half their length.

On dead branchlets of *Acer nigrum* Michx. f., near London, Ontario, November, 1903, *J. Dearness 3046*. The late Mr. J. B. Ellis examined this species and pronounced it a new one, but he is not responsible for any errors there may be in the above description.

12. **Cytodiplospora parallela** sp. nov.

Stromata erumpent, verruciform to elongate, 0.5–2 mm., sometimes scattered, but mostly in somewhat broken parallel lines, when well developed containing 5 to 15 pycnidia or locules which in tangential section are distinctly visible by their whiteness against the black stromatic substance. Pycnidia wholly or partially immersed,—in the latter case seeming cespitose,—papillate, 90–150 μ. Conidia hyaline, pyriform, uniseptate, subsessile, 12 $\times$ 6 μ.

On *Acer nigrum* Michx. f., Byron, Ontario, October–November, 1903, *J. Dearness 3206*.

13. **Ascochyta Achlydis** sp. nov.

Spots scattered, numerous small ones 2 mm., mostly sterile and a few large ones 1 cm. or more in diameter, all with a central, sharply deliminated, thin, arid, deciduous area surrounded by a

diffuse, dark-red or purple-brown border 1–5 mm. in width. Pycnidia nearly concolorous with the arid area, epiphyllous, although visible from the under side, 150–200 μ. Conidia hyaline, obscurely 1-septate, 2–3-nucleate, rounded at the ends, 14–20 × 5–6.5 μ.

On living leaves of *Achlys triphylla* DC., Vancouver Island, June, 1915, *John Macoun.*

14. **Diplodia constricta** sp. nov.

Pycnidia thickly scattered mostly along one side of the stems, small, 0.2–0.4 mm., showing the very short ostiola through a stellate or simply cleft rupture of the epidermis. Conidia dark-brown, strongly constricted, 18–22 × 9–10 μ.

On dead stems of *Spiraea Menziesii* Hook., British Columbia, June, 1915, *John Macoun.* Of the several Diplodias on species of *Spiraea* this comes nearest *D. Spiraeae* Thüm. Sacc. Syll. III. p. 342.

15. **Diplodia Ulmi** sp. nov.

Pycnidia thickly scattered, 250–400 μ, single or in small groups, subglobose, immersed in the unaltered cortex, raising the epidermis into small pustules which are scarcely visibly ruptured by the minute ostiola. Conidia brown, elliptic, constricted, 15–17 × 9–10 μ.

On dead branchlets of *Ulmus americana* L., London, Ontario, October, 1903, *J. Dearness 3052.* The bark externally is so slightly altered in appearance that the presence of the fungus is apt to escape notice, but in a tangential shaving the black shining pycnidia strongly contrast with the pale cortex.

16. **Diplodia Nuttalliae** sp. nov.

Pycnidia seated around the lenticels through which the fungus seems to have invaded the host, slaty-brown in section but the basidial portion white, 0.5–1 mm. Conidia dark-brown when fully mature, oblong-elliptic, even or but slightly constricted at the septum, 18–24 × 7–9 μ, on basidia 4 μ thick, sometimes longer than the spore.

On *Nuttallia cerasiformis* Torr. & Gr. Victoria, B. C., April, 1915, *John Macoun.*

17. **Stagonospora Spiraeae** sp. nov.

Pycnidia scattered, nearly superficial, globose or elliptic, brown, smooth, 0.3–0.6 mm. Conidia hyaline, 3-septate, 14–20, mostly $15 \times 3\,\mu$.

On dead stems of *Spiraea Menziesii* Hook., British Columbia, May, 1915, *John Macoun*. On pale areas of the stems similar to those bearing *Belonidium Macounii* Dearness described on a preceding page, and to which it may be related. *Stagonospora Physocarpi* Ellis & Ev. has spores $25–35 \times 3–4\,\mu$.

18. **Septoria adenocaulonis** sp. nov.

Spots amphigenous, thickly scattered, on the upper side grayish-brown, nearly concealed below by the pubescence of the leaf, small, 2 to 3 mm., bounded by a sharply raised thin border. Pycnidia epiphyllous, single or a small cluster near the center of the spot, yellowish-brown, $60–75\,\mu$, wall very thin. Sporules straight, continuous, $15–30 \times 1\,\mu$, issuing as whitish cirrhi from many of the pycnidia.

On living leaves of *Adenocaulon bicolor* Hook., British Columbia, May, 1915, *John Macoun*. This is near *Septoria Lapparum* Sacc. whose spores are subfusoid.

19. **Septoria angularis** Dearness & Bartholomew, sp. nov.

Spots scattered over the leaf, numerous, brown, becoming arid, limited when the pycnidia are well developed by a narrow, raised, sharply defined, black border, angular, 2 to 5 mm. and becoming confluent. Pycnidia black, epiphyllous, rather numerous, often marked by a whitish cirrhi, $40–90\,\mu$. Sporules straight to strongly curved, continuous, $30–45 \times 2\,\mu$, mostly $35\,\mu$.

On living leaves of *Solidago latifolia* L., Komoka, Ontario, June, 1913, *J. Dearness 3612*.

This comes near *S. fumosa* Pk. on *Solidago Canadensis* L. Affected leaves seem easily distinguishable and yet it might have been better to consider this a species variety of *S. fumosa*.

20. **Septoria lupincola** sp. nov.

Spots grayish-brown, determinate above, paler and less definite below, seldom crossing the midrib, 3 to 7 mm. Pycnidia dark-amber color, epiphyllous, $75–180\,\mu$. Sporules linear, continuous, $28–70\,\mu$, mostly about $35 \times 1–1.25\,\mu$.

On living leaves of *Lupinus perennis* L., Oakland, near London, Ontario, July, 1911, *J. Dearness 3633*. Associated with *Ascochyta Pisi* Lib. f. *Lupini, fide* Saccardo.

Septoria Lupini Hark. has sporules 4–5 μ thick. This is nearer *S. Pisi* West., but it differs in its pycnidial wall and shape and length of sporules.

21. **Septoria sanguinea** sp. nov.

Spots rusty-brown, scattered, similar on both sides, circular, about 3 mm. in diameter but extensively confluent on tips and margins. Pycnidia hypophyllous, nearly concolorous with the spot, hardly visible with the lens, wall thin, mostly about 80 μ. Sporules continuous or 1–2-septate, 28–33 × 2 μ.

On living leaves of *Ribes sanguineum* Pursh, British Columbia, September, 1914, *John Macoun*. Also at Manette, Wash., August, 1912, *E. Bartholomew*.

21a. **Septoria Macrosporia** sp. nov.

The pycnidia develop in indefinite areas of leaden color, opaque when held to the light, amphigenous, innate, thin-walled, perforate, darker than the surrounding surface, 90–180 μ. Sporules linear to linear-clavulate, mostly straight, 0–8 septate, beaded or guttulate, 60 × 3–4 μ, extreme size 120 × 4.5 μ.

On living leaves of *Chrysanthemum leucanthemum* L., London, Ont., October, 1915, *J. Dearness 3855*. Cotypic material, Fungi Columbiani 4774. The spores are much larger than those of *S. Chrysanthemi* Halsted or of *S. Chrysanthemi* Cavarra. The presence of a thin pycnidial wall separates this from *Cylindrosporium Chrysanthemi* Ellis & Dearness on Chinese chrysanthemum in the greenhouse.

22. CAMAROSPORIUM CORONILLAE Sacc. et Speg. var. SPIRAEAE Bauml. Sacc. Syll. Fung. **10**: 340. 1902.

Dr. Macoun sends a *Camarosporium* on *Spiraea Menziesii* Hook. from Vancouver Island, British Columbia, with black, gregarious, semi-immersed pycnidia 0.5–0.7 mm., containing dark-brown, muriform, oblong-elliptic conidia 14–17 × 8–9 μ, which may be the above named variety. It does not agree with *C. Spiraeae* Cooke.

23. **Leptostromella conigena** sp. nov.

Pycnidia elongate, 0.5–1.5 mm., parallel to the fiber of the bract, erumpent, carbonous, rather widely cleft. Conidia hyaline, 11–45 × 2–2.5 μ, mostly about 12 × 2.25 μ on basidia of nearly equal length.

On the outer side of bracts of cones of *Picea abies* (L.) Karst. of the preceding season's growth, London, Ontario, April, 1915, *J. Dearness, 3944.*

24. **Melanconium parvulum** Dearness & Bartholomew, sp. nov.

Acervuli 1–2 mm. across, lodged on the cortex and closely covered by the raised epidermis which opens by a circular perforation .3 mm. in diameter, through which usually the whitish core of altered cortical tissue is apparent. Conidia pyriform, brown, with a nucleus or pale center, 9–13 × 8–9 μ on basidia 10–30 × 3 μ.

On dead banchlets of *Betula populifolia* Marsh, southeast shore of Lake Huron, Ontario, Canada, May 25, 1912, *J. Dearness.* Barth. Fungi Col. *3823* is cotypic material.

25. CYLINDROSPORIUM CRATAEGI Ellis & Ev. Proc. Phil. Acad. Nat. Sci. **1894**: 372. 1894. **brevispina** var. nov.

Acervuli strictly hypophyllous, affected leaves red—pomegranate purple (Ridg.)—at first then turning brown. Sporules thicker in the proximal half, mostly straight, grumous-guttulate, obscurely 2–3-septate, 50–90 × 3–3.5 μ, leaving when completely discharged a distinct cavity in the mesophyll. As in the type the exuded conidia make a white flocculent layer over and around the acervuli.

On *Crataegus brevispina,* British Columbia, September, 1914, *John Macoun.*

26. CYLINDROSPORIUM TOXICODENDRI (Curtis in Herb.) Ellis & Ev. Proc. Acad. Nat. Sci. Phil. **1893**: 460. 1893.

Septoria Toxicodendri Curtis; Peck, Ann. Rep. N. Y. State Mus. **29**: 78. 1878. (No description.)

Gloeosporium Toxicodendri Ellis & Martin; Ellis & Ev. Jour. Myc. **1**: 116. 1885.

Septoria Toxicodendri (Curtis) Ellis & Martin, Jour. Myc. **3**: 77. 1887. (Doubtless described from herbarium material.)

Marssonina Toxicodendri Magn. Hedwigia **45**: 90. 1906.

On living leaves of *Rhus Toxicodendron* and other species.

Exsicc. N. Am. Fungi *1898, 2447 a & b;* Fungi Col. *447, 1350, 2635, 4429, 4430, 4734.*

I have had the opportunity of studying what might be regarded as two of the cotypes as well as specimens from several herbaria and several collections of my own made in widely separated localities, and find them all remarkably uniform in maculae and acervuli and varying in conidia. The synonymy is quoted to illustrate the difficulty of determining in some cases whether there is a proper pycnidium. Curtis, Peck, Ellis, and Martin took this plant to be a *Septoria* and the dark cells overlying the acervuli might be supposed to be part of a pycnidial wall. It is to be noticed that it was described both as a *Septoria* and a *Gloeosporium* by the same authors. It also illustrates another difficulty—that of determining the genus by the spore-form. In a section through a single spot cutting three acervuli there were conidia exhibiting the following variations:

$21 \times 4\,\mu$	1-septate
$18 \times 5\,\mu$	0-septate
$51 \times 3\,\mu$	3-septate
$60 \times 3\,\mu$	2-septate

Conidia from extreme, isolated, examples might very well place this species in *Marsonia,* or *Septogloeum,* or *Cylindrosporium.* Four of the Fungi Col. numbers are labeled *Marsonia* as in the above synonymy, but in one of them, on *Rhus diversiloba,* the spores in my specimen are mostly nearly $50\,\mu$, obscurely septate, and one—the longest measured—was $78 \times 3\,\mu$ in which, if there were any septa, they were quite obscured by the nucleation. In 1893, Mr. Ellis stated that he had reexamined *Gloeosporium Toxicodendri* Ellis & Martin and found that the spores ("12–15 × 5–6 μ") had been erroneously described in Jour. Myc. **I**: 115. I have, however, seen short spores not far from these figures, but the average spore of a large number of studies certainly places this plant in *Cylindrosporium.*

27. **Cryptosporium falcatum** sp. nov.

Acervuli 40–260 μ, gregarious in irregular patches, 2–6 cm. across, erumpent in minute pustules, noticeable on account of the white masses of ejected spores. Conidia hyaline, falcate, nucleate, 20–35 $\times$ 6–8 μ, mostly about 30 $\times$ 7 μ.

On bark of the trunks of unhealthy or dead *Abies balsamea* (L.) Mill., near London, Ontario, April–May, 1915, *J. Dearness 3797*.

28. RAMULARIA LAPSANAE (Desm.) Sacc.

Oidium fusisporioides f. Lapsanae Desm.

Collected on *Lapsana communis* L. at Elora, Ont., July, 1915, *J. Dearness 3835*. The indefinite arescent areas caused by the fungus are indistinguishable from the discolorations produced by the red spider, *Tetranychus telarius*. This may account for the fact that this fungus has not hitherto been recorded here.

29. **Stemphylium nemopanthes** sp. nov.

Hyphae usually shorter than the conidia, hyaline, branched, 4–5 μ thick, making with the conidia black, gregarious tufts, 100–200 μ. Conidia irregularly pyriform, acrogenous on the hyphae and branches, 30–35 $\times$ 20–24 μ, made up of dark-brown shining cells 3–4 μ, not separating.

On outer bark of dead *Nemopanthes mucronata* (L.) Trel., London, Ontario, June, 1915, *J. Dearness 3825*.

LONDON, ONTARIO,
CANADA.

NOTES AND BRIEF ARTICLES

Professor A. J. Pieters describes and illustrates *Achlea Klebsiana* sp. nov. and *Saprolegnia Kauffmaniana* sp. nov. in the December number of the *Botanical Gazette*.

Mr. R. C. Faulwetter, of Columbia University, has been appointed plant pathologist of the Agricultural Experiment Station of South Carolina at Clemson College.

Professor Paul Sorauer, of the University of Berlin, widely known for his work on plant pathology, recently died at the age of seventy-seven years.

Professor H. H. Whetzel, of the department of plant pathology, Cornell University, and Dr. E. W. Olive, of the Brooklyn Botanic Garden, sailed for Porto Rico on February 19 to study fungi and plant diseases.

Mr. Irving E. Melhus, formerly pathologist in the Bureau of Plant Industry at Washington, is now associate professor of plant pathology in the Iowa State College, at Ames, Iowa.

Dr. J. J. Taubenhaus, associate plant pathologist of the Delaware Agricultral Experiment Station, has accepted the position of head plant pathologist and physiologist at the Agricultural Experiment Station, College Station, Texas.

At the meeting of the Society of American Bacteriologists held at the University of Illinois at the end of December, Dr. Thomas J. Burrill, formerly vice-president of the university, was elected president of the society for the coming year.

Dr. W. J. Robbins, instructor in botany in the New York State College of Agriculture, has been appointed botanist in the

Alabama Polytechnic Institute to fill the vacancy made by the resignation of Dr. J. S. Caldwell, who has been called to the Washington Agricultural Experiment Station.

Miss Mary K. Bryan has found that the nasturtium is subject to a bacterial wilt disease, which prevents blossoming, stunts the plants, and finally kills them. The causal organism is *Bacterium solanacearum* Erw. Sm. Miss Bryan's results were published in the *Journal of Agricultural Research* of August 16, 1915.

Associate Professor H. P. Barss has been promoted to be professor of botany and plant pathology at the Oregon Agricultural College in place of Professor H. S. Jackson, who recently resigned to accept the position of plant pathologist at Purdue University.

"A Honeycomb Heart-rot of Oaks Caused by Stereum subpileatum," by W. H. Long, appeared in the *Journal of Agricultural Research* of December 6, 1915. The disease is rather widely distributed in the southern United States and is one of the important heart-rots of our native oaks. The only known method of control is the destruction of all diseased timber containing the rot.

A bulletin on the "Phytophthora Disease of Ginseng," by Joseph Rosenbaum, was published by the Department of Plant Pathology of Cornell University in October, 1915. The fungus is said to resemble most closely *Phytophthora cactorum* (Cohn & Leb.) Schröt. The suggested methods of control include spraying, removal of diseased plants, deep planting, crop rotation, sterilization of the soil, and drainage.

The officers for the Botanical Society of America for the coming year are: *President,* R. A. Harper; *Vice-President,* G. T. Moore; *Treasurer,* Arthur Hollick; *Secretary,* H. H. Bartlett. The society voted to eliminate the class of membership heretofore known as fellows, but failed to create a class of honorary membership as outlined in a proposed amendment to the constitution.

In a recent circular on "Wood Decay in Orchard Trees in California," by W. T. Horne, attention is called to the frequent occurrence of rots affecting orchard trees, in many cases apple and stone-fruit trees being seriously attacked by wood-destroying fungi. The author recommends cutting out, disinfecting, and coating the wounds with asphaltum. The trees should be inspected at the end of the summer and the disinfection renewed if necessary.

Dr. N. Patouillard has an article in the *Philippine Journal of Science* for March, 1915, on fungi sent to him from the Philippines by Professor C. F. Baker. The article contains a long list of determinations and also the following new species: *Septobasidium laxum, Hymenochaete pavonia, Duportella velutina, Duportella Raimundoi, Leucoporus ameides, Leptoporus Bakeri, Leptoporus armatus, Hexagona lachnochaeta, Elmerina foliacea, Daedalea philippinensis, Ganoderma Bakeri, Ganoderma plicatum,* and *Crinipellis fragilis.*

A bulletin on "Insects as Carriers of the Chestnut Blight Fungus," by R. A. Studhalter and A. G. Ruggles, was recently published by the Department of Forestry of Pennsylvania, in which experiments with ants, spiders, beetles, flies, and other kinds of insects are outlined, and it is shown conclusively that insects are largely instrumental in the dissemination of the chestnut canker and many other injurious fungi. The bulletin also contains an interesting historical summary of the experiments thus far made with insects as carriers of fungous spores.

Professor E. A. Burt, mycologist of the Missouri Botanical Garden, visited the Garden February 12–17 to examine the collection of Thelephoraceae in the mycological herbarium. He has been publishing a series of papers on this important and difficult family, which he hopes to complete within the next three years. He will then prepare descriptions of the species for publication in *North American Flora.* Professor Burt's visit was made the occasion of a dinner to over twenty local mycologists and other botanists, given by Professor Harper on the evening of February 16 at the Columbia Faculty Club.

At the seventh annual meeting of the American Phytopathological Society, held at Columbus, Ohio, from December 28 to 31, the following officers were elected: *President,* Dr. Erwin F. Smith, Bureau of Plant Industry, Washington, D. C.; *Vice-president,* Dr. Mel. T. Cook, New Jersey Agricultural Experiment Station, New Brunswick, N. J.; *Secretary-Treasurer,* Dr. C. L. Shear, Bureau of Plant Industry, Washington, D. C.; *Councilor,* Dr. F. D. Kern, Pennsylvania State College, Pa. Dr. W. A. Orton was elected one of the chief editors of *Phytopathology,* and Professor H. T. Güssow, Dr. C. W. Edgerton, Dr. E. C. Stakman, and Dr. V. B. Stewart were elected associate editors.

A bulletin on "Melaxuma of the English Walnut," by H. S. Fawcett, has recently been published by the California Horticultural Commission. This disease causes black cankers and exudation of black sap on the large limbs and trunks of English walnut trees in Santa Barbara County and certain other counties in California. It is infectious, being caused by a species of *Dothiorella* which also attacks a willow in that vicinity, poles of which are often used to drop the lower limbs of the walnut trees. If not too far advanced, it may be controlled by cutting out the cankers and dead limbs and treating the wounds with strong lime-sulphur or with Bordeaux paste.

An important professional paper on "The Toxicity to Fungi of Various Oils and Salts, Particularly Those Used in Wood Preservation," by C. J. Humphrey and Ruth M. Fleming, recently appeared as Bulletin No. 227 of the United States Department of Agriculture. The authors conclude that the common molds are more resistant to poisons than the true wood-destroying fungi, and even among the latter group the different species show a great difference in susceptibility. The results of tests on eighteen wood preservatives at the Forest-Products Laboratory, against two wood-destroying fungi, *Fomes annosus* Fr. and *F. pinicola* (Sw.) Fr., are given. Preservatives act in a considerably different manner on these two organisms, the former being, as a rule, far more resistant.

Another bulletin on "Citrus Canker," by H. E. Stevens, has been published by the Agricultural Experiment Station of the University of Florida. This bacterial disease, caused by *Pseudomonas Citri* Hasse, has proved to be the worst plant disease that has appeared in Florida and seriously threatens the citrus industry of the state, as well as of the entire South. It affects all parts of the tree above ground and attacks most of the varieties of *Citrus* grown in Florida. The bacteria are capable of considerable desiccation and retain their vitality for long periods. The complete destruction of all infected trees is the only known effective method of checking the spread of the disease, and this must be done very promptly if it is to be successful.

The February number of *Phytopathology,* which is both large and attractive, contains a long list of important articles and also abstracts of all the papers presented at the Seventh Annual Meeting of the American Phytopathological Society at Columbus, Ohio, December 28–31, 1915. Among the articles, the following may be mentioned: "Mordecai Cubitt Cooke," by H. T. Güssow, "The leaf blotch disease of horse-chestnut," by V. B. Stewart, "Some bark diseases of citrus trees in Florida," by J. G. Grossenbacher, "International phytopathology," by Otto Appel, "Identity of Peridermium montanum with Peridermium acicolum," by George Grant Hedgcock, and "The control of experimental conditions in phytopathological research," by Alden A. Potter.

An article on the discovery of the chestnut canker (*Endothia parasitica*) in Japan by Mr. Frank N. Meyer appeared in *Science,* February 4, 1916, contributed by C. L. Shear and Neil E. Stevens. About two years ago, Mr. Meyer discovered the chestnut canker in China. In a letter dated September 20, 1915, Mr. Meyer stated that the chestnut canker was quite common in Japan, at least around Nikko, Tokio, and Yokohama, both wild and cultivated trees being attacked but showing considerable power of resistance. Mr. Meyer sent some of his collections to Dr. Shear, who found them to be absolutely identical with material collected in the United States on the wild chestnut tree. On January 8,

1916, Dr. Shear received a specimen of chestnut canker from Dr. Yamada, of the Morioka Imperial College of Agriculture and Forestry, who attributed his discovery of the disease to a familiarity with the fungus gained on a recent visit to the United States. *Endothia radicalis* is also indigenous in Japan on various hosts and has been confused with the true chestnut canker, which it very much resembles.

AN ATTRACTIVE SPECIES OF MELANOLEUCA FROM OREGON

Melanoleuca olivaceiflava Murrill, sp. nov.

Pileus fleshy, convex to subexpanded, solitary, 2.5–3 cm. broad; surface smooth, dry, opaque, subtomentose, soft like a kid glove, not striate, very dark olivaceous, margin concolorous, entire, inflexed on drying: lamellae sinuate-adnexed, crowded, broad, ventricose, flavous: spores oblong-ellipsoid, smooth, hyaline, 12–16 × 4–5.5 μ: stipe short, thick, tapering downward, solid, fleshy, flavous, becoming brownish when bruised, 2 cm. long, 8 mm. thick.

Type collected on the ground in mixed woods at Corvallis, Oregon, November 6–11, 1911, *W. A. Murrill 948* (herb. N. Y. Bot. Gard.). This species is very conspicuous on account of its dark-olive pileus and bright-yellow lamellae and stipe. The spores are also quite remarkable, being very long and narrow. The plant is known only from the original collection.

W. A. MURRILL.

INSECTS AND MUSHROOMS

In Henri Fabre's "The Life of the Fly," a translation of which has been published by Dodd, Mead, and Company, there is a chapter devoted to insects and mushrooms, in which reference is first made to the widespread belief that mushrooms eaten by insect larvae are safe for human beings. The author then proceeds to describe in an interesting way what he observed in the neighborhood of Sérignan.

Of the chewing insects, he mentions four beetles and a moth-caterpillar. One of the beetles specializes on *Pholiota aegerita*, one attacks *Polyporus hispidus*, and the other two are partial to truffles. The caterpillar, about one fifth of an inch long, is the habitual boarder of all kinds of fleshy agarics and boleti. The

chewers, to which group may be added the snails, all dig clean passages and break their food into minute particles. The flies, on the other hand, when in the maggot stage liquefy the flesh of the mushroom, dissolving it by means of a special pepsin as do the bluebottle maggots of meat.

The caterpillar and the maggots, as observed by Fabre, greedily devoured *Boletus Satanas,* but refused all species of *Amanita,* whether edible or poisonous; while the mild *Lactaria deliciosa* and the acrid *Lactaria torminosa,* the poisonous *Pleurotus phosphoreus* and the edible *Pleurotus Eryngii,* proved equally attractive to these insects. The author concludes that the selection of mushrooms by insects is no criterion for the human mycophagist.

Then follows a *very inaccurate and dangerous statement,* to the effect that no one was ever poisoned at Sérignan by eating mushrooms because it was the custom to "blanch" them, or bring them to the boiling point in water with a little salt added, and then to rinse them a few times in cold water. The "poisonous" species mentioned as treated in this way are *Armillaria mellea, Boletus Satanas, Lactaria zonaria, Amanita pantherina, Amanita muscaria,* and *Pleurotus phosphoreus;* some of which are entirely harmless, some are rendered harmless by boiling, and the rest contain as their active poisonous principle the alkaloid muscarin, which is soluble in hot water. If *Amanita phalloides* had accidentally come into the experiment, the conclusion would have been very different. Romell, of Sweden, doubted *Entoloma lividum* and tried boiling it for five minutes and throwing the water away;—he narrowly escaped death.

Attention is called to Dr. Clark's note on this subject in *Mycologia* for July, 1912, which closes with the following statement: "*Amanita phalloides* still preserves its toxic principle unchanged after being heated to boiling for some time; in the dried state its toxicity is not weakened after standing a year nor has it lost its poisonous properties after remaining dry for six years; the poison is still held in the tissues of the mushroom after boiling with water.

"Therefore it is very unwise to spread broadcast the erroneous idea that all poisonous mushrooms may be rendered harmless by boiling with water and then washing repeatedly in cold water."

W. A. MURRILL.

MARASMIUS ON SUGAR CANE

Fulton in Bulletin No. 100 of the Louisiana Experiment Station reported *Marasmius plicatus* on sugar cane. His description of "stipe whitish" differs so much from that of the original *M. plicatus* Wakker as to lead one to suspect another fungus. My own dried material of *Marasmius* on sugar cane from Louisiana and Texas answers to the description of *M. stenophyllus* or its synonym *M. semiustis*. As I recall the form in the field, the pileus occasionally presents a purplish color. This corresponds with material occurring on sugar cane in Cuba and common on certain varieties of banana. Dr. Murrill identified my material from sugar cane and banana as *M. stenophyllus*.

Unfortunately, no one in this part of the world has been able to compare material with the original *M. plicatus* described by Wakker and Went, from Java, but nevertheless all the available evidence seems to show clearly that the species of *Marasmius* parasitic on sugar cane in the Southern United States and occasionally parasitic on sugar cane and common on bananas in Cuba is *M. stenophyllus*.

The more common species of *Marasmius* on sugar cane is commonly known as *M. Sacchari*. This answers well to the original description by Wakker and Went, and, moreover, Went identified material in Trinidad as such (see Went, "Waarnemingen en opmerkingen omtrennt de Rietsuiker industrie in West Indie"). *M. Sacchari* appears to occur throughout the West Indies as a parasite of sugar cane and to its damage is assigned the main reason for giving up the Bourbon cane and the adoption of seedling and other varieties. *M. stenophyllus* is reported on bananas in many West Indian islands, but has not been reported before on sugar cane.

These two species are very similar, although *M. stenophyllus* occasionally has a purplish pileus, while *M. Sacchari* never does so far as I know. The only safe criterion for separating the species is the spore form and size, the spores of *M. stenophyllus* being ellipsoid, $7–9 \times 5–6\,\mu$, and the spores of *M. Sacchari* being irregularly elongate, often slightly curved, larger at one end than at the other, and $16–20 \times 4–5\,\mu$.

J. R. JOHNSTON.

INDEX TO AMERICAN MYCOLOGICAL LITERATURE

Arthur, J. C. New species of Uredineae—IX. Bull. Torrey Club **42**: 585–593. 13 N 1915.

Includes 11 new species in *Uropyxis* (1), *Uromyces* (2), *Puccinia* (6), *Uredo* (1), and *Aecidium* (1).

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